JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES
VOL. 27 SEPTEMBER 15, 1937 NO. 9

CHEMISTRY.—*Some aspects of the study of insulin.*[1] VINCENT DU VIGNEAUD, George Washington University.

Mr. President, fellow-members of the Washington Chemical Society, I wish to thank you for this award. I deeply appreciate it. There is nothing that so warms one's heart as the recognition of one's work by his fellow workers. In accepting this award, I should like to make sincere acknowledgment of the loyal and enthusiastic cooperation of a group of graduate and post-graduate students, whom I have had the pleasure of working with in these sulfur studies. I should like to mention particularly Lewis Butz, Wilbur Patterson, Hubert Loring, Helen Dyer, Chase Jones and Gail Miller. Your tribute I feel is as much to them and their work as to me and the part that I have played in the accomplishment of these researches. On their behalf as well as my own permit me to thank you once more.

In addressing you this evening, I shall not discuss with you the researches directly mentioned in your award, that is, the synthesis of glutathione, nor the fields closely allied to it on the cystinyl peptides and homocystine, for all of these researches have been presented before this society on former occasions. I thought I would discuss with you, instead, the problem out of which these researches arose and the possible significance that these studies may have in the understanding of the original problem. I think it is always interesting to trace the origin of research ideas. Seldom do ideas spring forth wholly formed as did the goddess Athena from the brow of Zeus; nor are they spontaneously generated. They are no more spontaneously generated than living matter itself. Ideas are propagated by other ideas, and develop slowly, nurtured by facts and observation. It is in this way, step by step, that a research program develops, and it is interesting and sometimes profitable to retrace the devious trail along which it has traveled. It is like tracing the family tree of research.

Most of our own researches in the field of sulfur chemistry have

[1] Address on the occasion of the award of the Hillebrand Prize for 1936, delivered before the Chemical Society of Washington, March 11, 1937. Received March 29, 1937.

had their outgrowth from our studies on the chemistry of insulin. In some instances the new research problem has arisen unexpectedly, as did the homocystine problem through our trying to work out a particular phase of the chemistry of insulin; while in other instances the researches have come about through a realization that more fundamental knowledge was needed of the chemistry of certain compounds in order the better to understand the chemistry of insulin, as exemplified by our studies on cystine and cystinyl peptides. At first sight many of these sulfur problems might appear to have no connection with insulin. It is true they have seemingly wandered far afield, but there is an underlying connection. I shall endeavor to show you this connection and how some of these problems have arisen. I shall also try to interweave through this discussion some of the results of our own studies of insulin itself, and finally present to you a glimpse of our present chemical knowledge of this hormone and the effect which the study of insulin has had on our conception of proteins and certain other hormones.

Quite early in the study of insulin it was suspected by various workers that insulin might be a sulfur-containing compound. This was very shortly after the demonstration, with which you are all acquainted, of the presence of this hormone in the pancreas by Banting and Best in 1921. It was not until 1926, however, that the suspicion of its being a sulfur compound grew into a very definite possibility out of the work of Professor Abel of Johns Hopkins. It is rather interesting how this came about. Professor Abel had heated some insulin preparations with phenol in sealed tubes for some purpose, and, when one of the tubes was opened, Professor Abel noticed an odor of hydrogen sulfide. He followed this up and subsequently found that the amount of sulfur, labile to weak alkali, paralleled the activity of certain preparations, and that when the sulfur was split out, the activity was destroyed. Shortly thereafter he succeeded in isolating insulin in crystalline form. He found that the crystalline material likewise contained sulfur in a labile form. These findings led Abel to suggest that the Islets of Langerhans might be dependent upon the presence in our food of a special labile sulfur compound, a precursor indispensable for the elaboration of the hormone, in the absence of an adequate supply of which pathological alterations in the cells of the Islets of Langerhans would take place. It is quite clear that the question of the identity of the sulfur moiety became one of paramount importance.

At that time we were studying the problem at Rochester in Pro-

fessor Murlin's department and had obtained evidence that the insulin contained cystine and that the labile sulfur could be accounted for on that basis. When the sulfur was split out, the disulfide linkage was destroyed and the test for cystine greatly reduced in intensity, indicating that the cystine was the source of the labile sulfur. Although the sulfur of the insulin was labile, the sulfur in the hydrolysate of the insulin became stable like that of free cystine. This change in lability upon hydrolysis was identical with what would be expected of amino acid derivatives of cystine based on the work of Brand on the lability of the sulfur of peptides of cystine. In this work at Rochester we were also able to confirm Abel's crystallization of insulin.

From our studies we came to the conclusion that the sulfur was present as the disulfide linkage and that insulin was most likely a derivative of cystine, and we suggested that cystine in insulin was linked to the rest of the molecule by peptide linkages.

The conclusive demonstration of the actual presence of cystine in crystalline insulin, however, had to rest on isolation; so later, when we had the opportunity of working in Professor Abel's laboratory, we took up the isolation of cystine from crystalline insulin. Of course, this isolation work had to be carried out on a very small scale and we had to work out our own methods. We hydrolyzed a gram of crystalline insulin and immediately ran into difficulties with the isolation of the cystine. We soon recognized that one of the difficulties was that we had partially racemized the cystine, and in looking into the literature we found that racemized cystine was far more soluble than *l*-cystine. It was here that our interest in the isomers of cystine arose. We found that in spite of the great amount of work that had been done on the problem, the isomers had not been isolated and, in fact, there was much difference of opinion as to whether the inactive material was the meso or racemic form or a mixture of the two. Somewhat later when the opportunity arose we undertook the resolution of cystine, and succeeded in isolating the other isomers of cystine, the dextrorotatory form, the racemic and the meso forms. We then became interested in the utilization of the isomers by the animal body and studied their ability to promote growth of animals on a cystine-deficient diet, finding that the *d*-isomer could not be utilized. This in turn led to studies of oxidation of these isomers and also to the behavior of the optical isomers of other amino acids in the body. It also made possible a study of the solubilities of the isomers, and we were finally able to show why the mixture of isomers was so

soluble, which led us back to the point from which we had started some five years earlier in the insulin work.

To go back now to the isolation of cystine from crystalline insulin, I might say that this was readily accomplished when care was taken to avoid as much as possible the racemization of cystine, and when we had worked out a method which would separate tyrosine from cystine in such small quantities. Thus the isolation of cystine from the insulin demonstrated beyond any argument that cystine was present in the insulin molecule.

Knowing that cystine was present naturally brought many questions to mind. One of the first questions to arise was whether cystine peptides might affect the lowering of blood sugar. It was then we realized that as yet no peptide of cystine through the carboxyl group of cystine had been prepared, and that no method was available at the time for the accomplishment of this type of peptide synthesis. Cystinyl peptides were also necessary from other standpoints, both chemical and biological and, somewhat later, it was clear that such a step was vital for a convenient synthesis of glutathione. While continuing the insulin researches we, therefore, carried on parallel studies on the synthesis of peptides of cystine, the successful outcome of which placed us in a position to accomplish the synthesis of glutathione and isoglutathione.

The synthesis of glutathione, if I might say so, was really incidental to the larger study we were interested in, that is, cystinyl peptides. We were interested in the development of convenient and workable methods for getting these compounds and then in the study of their physiological and chemical properties. The experience gained with this tripeptide puts us one step further towards making more complicated peptides of cystine. What I should like to emphasize is that the glutathione synthesis was not an end in itself but merely a step in a general program.

In addition to knowing that cystine was present in insulin, it was important to know whether all of the sulfur was present as cystine sulfur or whether there was present some other sulfur-containing compound. We first determined the cystine content by the Folin-Looney method and by the amazingly specific Sullivan method. The Folin-Looney method gave much higher values than the Sullivan, and, in fact, higher than could be accounted for on the basis of the total sulfur. With the specific Sullivan method, only about three-fourths of the sulfur could be accounted for on the basis of cystine.

A number of possibilities might account for this situation. One, a strange sulfur compound might be present; two, a difficultly hydrolyzable peptide of cystine might have remained in the hydrolysate which would react in the Folin-Looney reaction but not in the Sullivan method; three, the cystine might be partially destroyed during hydrolysis; and, four, some substance might be generated during the hydrolysis which would account for the high Folin-Looney reaction; and, finally, various combinations of these possibilities might exist.

One of the first things we did when we undertook to settle this question was to heat various amino acids with hydrochloric acid and sulfuric acid to see if such treatment would produce substances that would be chromogenic with the Folin-Marenzi method, which was a modification of the Folin-Looney procedure.

Interestingly enough, methionine upon being heated with strong sulfuric acid was found to give a positive reaction with the Folin-Marenzi reagent for cystine. This was the start of our series of investigations concerning homocystine. In searching for the substance in the reaction mixture responsible for the positive test, we isolated a crystalline compound which we were able to demonstrate to be the next higher symmetrical homologue of cystine. The possibility of this compound being involved in the intermediary metabolism of methionine in the body immediately occurred to us. Investigations concerning the utilization of the homocystine by animals on a cystine-deficient diet and studies of the oxidation of the compound were therefore undertaken. Synthesis of the homocystine, resolution of it into its optical isomers, and the demonstration of the steric relationship between its isomers and those of methionine soon followed, as well as studies of the higher homologues of homocystine and methionine.

Although this observation of the effect of sulfuric acid on methionine led to some rather interesting results, it did not explain the particular thing we were after. In the first place, the difference between these reactions existed in hydrochloric acid hydrolysates, and hydrochloric acid did not yield a chromogenic substance from methionine; and, secondly, methionine was not present in insulin in more than traces, if at all. We still had the original question to solve, and we worked off and on on this problem during the next few years and just within the past few months we have obtained results which lead us to believe that we have finally accounted for the sulfur of insulin.

It is rather amusing that the entire homocystine work with which we have been engaged during the past six years would not have taken place had we been able to account for the sulfur of insulin at

that time. It is indeed curious the path which research may take, and perhaps it is these queer turns and quirks that make it fun to try to follow the pathway.

Although this particular path of homocystine researches appeared to have no connection with insulin, a recent turn of events has brought the two fields back together again and serves as an interesting example of how offshoots of a research may wander away and bend back again, touch, and even aid the original research. I refer here to the recent work on the question of whether or not a trace of methionine is present in crystalline insulin, and to the fact that one of the methods for determining methionine depends on the determination of the homocysteine thiolactone formed from methionine by hydriodic acid. I shall refer to this again later.

Along with attempts to fractionate insulin hydrolysates to see if a strange sulfur compound were present, and testing for the presence or absence of known sulfur-containing compounds such as thiolhistidine, we have also studied the question of the completeness of hydrolysis of insulin and the prevention of destruction of the cystine during hydrolysis.

To make a very long story short, after trying various procedures, we finally found that if we hydrolyzed insulin with twenty per cent hydrochloric acid and 50 per cent formic acid we were able to account by the Sullivan method for all of the sulfur as cystine within the experimental error of the method. We were able, furthermore, to adduce evidence that the previous low results were really due to a destruction of the cystine on the one hand and incomplete hydrolysis on the other.

Whether or not a trace of methionine is present cannot be stated definitely. Our own results on the study would indicate that if it is present at all it is even less than that reported by Brand. You can readily understand the difficulty of proving the presence or absence of a very slight trace of methionine in dealing with such a compound as insulin. One is dealing with such small amounts that one is at the borderline of the accuracy of the methods. Much more work will be needed before reaching a final decision.

Another aspect of the sulfur of insulin that has intrigued us, which even more forcibly brings out the importance of the sulfur, is the effect of reduction upon the activity of insulin. Earlier work had shown that various reducing agents destroyed the activity, but the reagents used were quite vigorous ones and one would have reason to believe that groupings other than the disulfide may have been re-

duced. We thought it would be rather interesting to study the effect of such mild reducing agents as cysteine and glutathione, which were more specific for the disulfide grouping. Even with such subtle reducing agents as these the insulin became inactivated. From much experimentation we finally came to the conclusion that the reduction of the disulfide grouping was the cause of the inactivation. It is interesting that reoxidation did not restore the activity. These results have been confirmed and extended by other workers, and it has been found that the rate of inactivation proceeds faster than that of reduction. This has led some to conclude that there are certain groupings particularly sensitive to reduction and that one or two disulfide linkages have a special function in insulin.

Our own tendency is to regard the architecture of the molecule as a whole as the important factor with regard to its hypoglycemic action and that any change which would produce a change in this architecture is apt to produce a destruction of physiological activity. From this standpoint no one particular disulfide linkage is necessarily more important than another as far as being responsible for the activity. The rupture of a given disulfide linkage might modify the architecture sufficiently to destroy its ability to bring about the oxidation of carbohydrates. Although the disulfide linkage *per se* may not be responsible for the insulin action, I should like to emphasize the fact that so far no one has split out or changed the disulfide grouping without destroying potency.

I would like to add, parenthetically, that there are some who speak in terms of a prosthetic grouping being present in insulin, that is, the presence of some smaller grouping attached to the protein molecule which is responsible for the activity; while there are others who like to speak of a nucleus of certain amino acids responsible for the activity as an integral part of the protein molecule. I should like to emphasize that at the present time these are assumptions. Of course, I do not mean to intimate that these things can not be so. There simply is no evidence for them as yet and one should recognize these views for the assumptions that they are. No criticism can be leveled, of course, at anyone for using them as working hypotheses.

In summing up what we actually know of the chemistry of insulin, we might say that all the evidence points towards the fact that insulin is a protein. But we must admit that from the standpoint of actual chemical structure we know very little about it, even though we probably know more about the chemistry of this protein than of any other. In fact, it is one of the most thoroughly studied proteins.

In judging what is known of the chemistry of insulin one should compare it, not with certain of the other hormones such as adrenalin or thyroxin, but rather with what is known of other crystalline proteins.

In closing I should like to call to your attention the role that insulin has played in bringing the field to the realization that a protein may have hormonal properties, or should I say, that a hormone could actually be a protein.

We almost forget now the strong prejudice that existed at the time of the isolation of crystalline insulin, that the crystalline material could not be the hormone because it was, to all intents and purposes, a protein. Yet as the work progressed the conclusion began to take form that insulin was truly a protein-like substance. The actual isolation of various amino acids from the compound, the study of the nitrogen distribution, the studies on the heat precipitation, the crystallization by various methods, and many other studies all pointed inevitably in this direction. As time went on the idea of a hormone being a protein became less objectionable to the field as a whole, and the possibility that other hormones might be proteins became plausible. This was true of the parathyroid hormone which controls calcium metabolism and the hormones of the pituitary gland—both the anterior and the posterior lobes. Of course, these latter hormones that I have just mentioned have defied isolation as yet, and we must withhold final judgment until they have been isolated, but the available evidence indicates that they are polypeptide or protein-like compounds.

This realization that a hormone could be a protein has been hastened by the recognition of other physiologically active substances which have also appeared to be proteins or protein-like substances. Within the past few years we have had the isolation of a number of enzymes starting with the isolation of urease in crystalline form by Sumner and culminating in the isolation of certain proteolytic enzymes, such as pepsin and trypsin, in crystalline form by Northrop. All of these crystalline enzymes appear to be proteins and present chemical problems quite analogous to insulin. The crystalline plant virus recently isolated by Stanley also appears to be a protein. Furthermore, it seems that toxins, antitoxins, antigens and antibodies and the like are proteins. We have, therefore, a growing list of compounds possessing remarkable physiological action, all of which appear to be proteins.

The studies that have been carried out on insulin become, therefore, of more fundamental value because of their possible significance to the study of these other crystalline physiologically active proteins. It should also be apparent from what I have just said about this entire group of substances that one of the greatest needs of biochemistry today is an understanding of protein structure itself.

PALEONTOLOGY.—Clithrocrinus, *new name for* Clistocrinus *Kirk.*[1] EDWIN KIRK, U. S. Geological Survey.

In this JOURNAL[2] I described a new genus to which I gave the name *Clistocrinus*. My attention has been called to the fact that Springer[3] had erected the genus *Cleistocrinus*. Incidentally, this latter name had previously appeared in print in error for *Cleiocrinus* Billings.[4]

Springer in describing the genus gave the Greek words from which he derived the name. They are the same as used by me. According to classical usage with these words as given, the generic name could be written *Clestocrinus* or *Clistocrinus*, with preference given the latter by the International Rules of Zoological Nomenclature. There is also a variant spelling in the Greek that would give *Clestocrinus* directly. *Cleistocrinus* is an improper transliteration of the words as given. However, there is an Ionic variant of the Greek that would give this spelling. It thus appears that properly transliterated *Clestocrinus*, *Cleistocrinus*, and *Clistocrinus* could all be derived from the Greek and with the same meaning. Pronunciation would vary with the nationality of the speaker.

There seems to be nothing in the Code clearly prohibiting the use of more than one of the variant spellings given above, although naturally their use should be discouraged. There is, however, owing to opinions handed down by the Commission, some doubt as to whether *Clistocrinus* Kirk is a homonym of *Cleistocrinus* Springer. In order to clarify the meaning of the Code and obtain a ruling from the Commission, I am proposing a new generic name to supplant *Clistocrinus*. I propose the name *Clithrocrinus*, with *C. pyriformis* (Kirk) as genotype. The genus and species thus stands as *Clithrocrinus pyriformis* (Kirk).

The doubtful status of *Clistocrinus* primarily rests on the incom-

[1] Published by permission of the Director, U. S. Geological Survey. Received July 21, 1937.

[2] This JOURNAL 27: 106. 1937.

[3] SPRINGER, FRANK. *The Crinoidea Flexibilia*. Smithsonian Inst. Pub. 2501, 1930.

[4] LUDWIG, H. Zool. Jahresber. for 1905, *Echinoderma*, pp. 4, 8, 1906.

patibility of Articles 8 and 19 of the Code. It may be held under Article 19 of the International Rules that *Cleistocrinus* is an error of transcription (*seu* transliteration) or a *lapsus calami* and should be changed to *Clistocrinus*. On the other hand, under Article 8 *k* and *l* words formed by an arbitrary combination of letters, or names formed by anagram, are held to be in good standing. If such be the case, rigid adherence to classical orthography and transliteration in isolated cases would seem to be hypercritical. After all, an improperly transliterated word may legitimately be considered an arbitrary combination of letters and would fall under Article 8 *k*. In a somewhat similar case (Opinion 26) nearly a hundred years after publication the Commission changed the spelling of a generic name on the somewhat easy assumption that a typographical error was involved. In the present instance one could as well assume that the typographical error or *lapsus calami* lay in the printing of the Greek word and that Springer really intended to use *Cleistocrinus*.

BOTANY.—*Eleven new Asteraceae from North and South America.*[1]

S. F. BLAKE, Bureau of Plant Industry.

This paper contains descriptions of eleven new species of Asteraceae (two from the United States, four from Mexico, five from South America), as well as two new varieties and several new names and combinations.

Bipontia Blake, nom. nov.

Soaresia Sch. Bip. Pollichia **20–21**: 376. 1863. Not *Soaresia* Allem. Rev. Braz. 1: 210. *pl.* 1857, and Arch. Palestr. Sci. Rio de Janeiro 1: 142. *pl.* 1858 (1859?).

Argyrophyllum Pohl, ex parte; Baker in Mart. Fl. Bras. 6^2: 150. 1873, as syn.

Bipontia velutina (Sch. Bip.) Blake.

Soaresia velutina Sch. Bip. Pollichia **20–21**: 377. 1863.

Argyrophyllum ovali-ellipticum Pohl; Baker in Mart. Fl. Bras. 6^2: 150. 1873, as syn.

In selecting a new name for this rare Brasilian monotype of the tribe Vernonieae I have sought to commemorate the work of Karl Heinrich Schultz (1805–1867), its original describer, one of the most active and enthusiastic students of Compositae of the last century, who was known as Schultz Bipontinus (from Zweibrücken, his birthplace) to distinguish him from a homonymous botanist of Berlin as well as from other botanists of the same family name. The fuller and preferable form, *Bipontinia*, is not

[1] Received June 23, 1937.

available for use, having been employed by Alefeld (1866) for a segregate from *Psoralea* now generally regarded as a synonym of that genus. The name *Bipontina* was published by Schultz[2] himself, but only as a section of *Matricaria*, and has never appeared in generic rank. Pohl's herbarium name *Argyrophyllum*, known only from its use in synonymy by Baker, deserves only to be passed over. It was employed by Pohl, according to Baker's synonymy, for two quite unrelated species, *Vernonia venosissima* Sch. Bip. (*Argyrophyllum lanceolato-ellipticum* Pohl; Baker, l. c. 30, a name omitted from Index Kewensis) and *Soaresia velutina* (*A. ovali-ellipticum* Pohl). The name *Argyrophyllum* is omitted from Engler & Prantl's Natürlichen Pflanzenfamilien and from Dalla Torre & Harms' Genera Siphonogamarum.

The earlier genus *Soaresia* Allemão is now referred to *Clarisia* R. & P. (Moraceae). The genus and its single species *Soaresia nitida* were published by Allamão (Archivos de Palestra Scientifica do Rio de Janeiro 1: 142. 1858 [1859?]) with a combined generic-specific description, which is valid publication according to the International Rules as revised in 1930. I have not seen the supposedly earlier publication of the same names in the Revista Brazileira, but it has been checked for me by Dr. L. R. Abrams in the Stanford University Library, and from his notes it would appear that the same text and plate that were published in the Archivos were published also in the Revista. The date of publication of both papers of Allemão is somewhat uncertain, but in any case is several years earlier than Schultz's use of the same name. In the Index Londinensis the date 1854 is assigned to Allemão's plate published in the Archivos, but this is merely the author's date at the close of his paper, which follows immediately another paper dated 1856. The title page date of the volume is 1858, but the Library of Congress copy bears in pencil the date 1859.

This change of name, obligatory under the International Rules, will cause little inconvenience, as the plant concerned is apparently very rare and has probably not been referred to in botanical literature more than half a dozen times. It is figured by Baker in the Flora Brasiliensis (6^2: *pl. 38*).

Alomia stenolepis Blake, sp. nov.

Herba, caule tenui glandulari-pilosulo et sparse longius piloso; folia opposita remota ovata acuminata basi subcordata dupliciter crenato-serrata utrinque viridia sparse pilosa et brevius glandulari-pilosa, petiolis aequilongis tenuibus glandulari-pilosis; capitula 105-flora per 3–8 in apicibus pedunculorum terminalium et e axillis superioribus orientium folia superantium subdense cymosa, pedicellis 3–6 mm longis; involucri paullum gradati 3–4-seriati 4 mm alti phyllaria angustissime linearia subsetaceo-acuminata parum pilosa et glandulari-pilosa; receptaculum nudum; achenia glanduloso-adspersa 1.4 mm longa.

"In a clump 0.6 m high and as broad"; stem with weak branches above, terete, striatulate, greenish, about 2 mm thick above, rather densely pilosulous

[2] Ueber die Tanac. 26. 1844.

with spreading white hairs about 0.1–0.3 mm long, tipped with purplish glands, and, especially above, more sparsely pilose with many-celled eglandular hairs about 0.7 mm long; uppermost internode 15–17 cm long; leaves opposite, or the uppermost alternate but approximate; petioles very slender, unmargined, purplish, glandular-pubescent like the stem, 3–5.5 cm long; blades ovate, 5–6 cm long, 3.5–4.7 cm wide, acuminate, at base subtruncate or shallowly cordate and often slightly inequilateral, thin, 3–5-nerved from the very base (the veins prominulous, the veinlets scarcely so), simply or usually doubly crenate-serrate essentially to the base (the teeth about 12–20 pairs, 1.5–3 mm high, obtusely callous-mucronulate), above sparsely short-pilose on veins and surface with several-celled mostly eglandular hairs, glabrescent, beneath equally green, on the veins pilose and with a few shorter hairs tipped with purplish glands, on the surface thinly short-pilose with many of the hairs tipped with pale yellow glands, or the latter often subsessile; peduncles terminal and in the uppermost axils, 3–5 per stem, pubescent like the stem, naked or with a single leaf-like bract, 5–10.5 cm long, very slender, bearing 3–8 heads; heads (as pressed) 5–6 mm high, 5 mm thick, hemispheric; involucre 3–4-seriate, slightly graduate, the phyllaries all similar, very narrowly linear (0.2–0.3 mm wide), rather firm, greenish with purplish tips, 2-ribbed, sparsely pilose and glandular-pubescent much like the stem; corollas very slender, deep purple above, subsessile-glandular below and on the teeth, otherwise glabrous, 3–3.3 mm long (tube 0.8–1 mm, throat scarcely distinguishable from tube, 2 mm, teeth ovate, obtusish, about 0.3 mm long); achenes 5-angled, sessile-glandular chiefly above, 1.4 mm long, blackish-brown, with short whitish crustaceous base and terminal whitish collar, epappose; styles (dried) white.

Mexico: On rocks at water's edge, in Lower Sonoran zone, Canyon Guadalupe, Sierra Chiribo, Rio Mayo, Sonora, 11 March 1935, *Howard S. Gentry* 1434 (type no. 766039, Field Mus.; photog. and fragm., U. S. Nat. Herb.).

In characters of involucre and corolla, this species seems somewhat intermediate between the subgenera *Geissanthodium* and *Eualomia* as distinguished by Robinson. The corollas, as in the first group, are not differentiated into tube and throat, and the phyllaries are 3–4-seriate. They are, however, firm and only 2-ribbed, and the species, on the whole, seems best referred to *Eualomia*. It is readily distinguished by its foliage, its pubescence, and especially by its very narrow phyllaries.

Chrysothamnus nauseosus var. **psilocarpus** Blake, var. nov.

Rami arcte flavescenti-viridi-tomentosi vix striati; folia anguste linearia 4–5.5 cm longa 1.5–2.5 mm lata acuminata plana 1–nervia lutescenti-viridia subglabra v. tenuiter laxeque pilosula; capitula cymoso-paniculata, paniculis planiusculis 3–5 cm latis; involucri gradati 3-seriati (seriebus perpendiculatis sat distinctis) 8.5–10 mm alti phyllaria exteriora lanceolata acuminata interiora lineari-lanceolata acuta (ca. 1.3 mm lata) omnia praecipue ad apicem ciliata dorso glabra vittato-carinata; corollae 10 mm longae (dentibus ovatis 1–1.2 mm longis inclusis) in tubo et basi faucis sparse puberulae pilis clavellatis; achenia glaberrima 5 mm longa; styli ramorum appendices (2.2 mm longae) parte stigmatifera (1.5–1.6 mm longa) sesqui longiores.

Utah: Huntington Canyon, Emery Co., 21 July 1935, *A. O. Garrett* 7021 (type no. 1,679, 641, U. S. Nat. Herb.); also 7048, same data.

In Hall & Clements' monograph of *Chrysothamnus*[3] this plant keys out to C. *nauseosus* ssp. *leiospermus* (A. Gray) Hall & Clements.[4] In that plant the leaves are filiform or nearly so, the involucre only 6–8 mm high, the corolla 5–8 mm long, and its lobes only about 0.5 mm long. From the two other forms of *C. nauseosus* with glabrous achenes, *C. nauseosus* var. *glareosus* (Jones) Hall and var. *bigelovii* (A. Gray) Hall, var. *psilocarpus* differs in its merely ciliate, not dorsally tomentose phyllaries. Var. *glareosus* differs also in its obtuse phyllaries, var. *bigelovii* in its nearly or quite filiform leaves.

APHANOSTEPHUS PINULENSIS Coulter, Bot. Gaz. 16: 98. 1891.

The type or type collection of this species, *J. D. Smith* 2407, from Pinula, Dept. Guatemala, Guatemala, alt. 1340 meters, came to the U. S. National Herbarium in the John Donnell Smith collection. It proves to be *Chrysanthemum parthenium* (L.) Bernh., a frequent escape from cultivation in Central America and Mexico.

Aster coahuilensis Blake, sp. nov.

Perennis bipedalis ubique (involucris exceptis) pilosus viridescens; folia inferiora ovata majuscula obtusa basi alte cordata papyracea grosse crenata longe petiolata, petiolis parum marginatis; folia media multo minora ovata acuminata crenato-serrata petiolis laminam semiaequantibus late marginatis prope basin saepe ampliatis; capitula vix numerosa (ca. 14–25 per caulem) mediocria corymboso-paniculata, bracteis ramealibus parvis linearibus v. subulatis; involucri turbinato-hemisphaerici 7 mm alti 4–5-seriati gradati phyllaria subappressa lineari-lanceolata acuta v. acuminata infra (circiter ad medium) indurata albida 1-sulcata supra herbacea (apice herbaceo anguste rhombico-lanceolato) sparse ciliolata ceterum glabra, exteriora calloso-apiculata; radii (sicc.) pallide violacea ca. 19 ca. 8 mm longa; achenia hispidula.

Herb 57 cm high, the stem (in the single specimen examined) bifurcate near the base, otherwise essentially simple below the inflorescence, green, subterete, not densely spreading-pilose with white hairs, eglandular; leaves rather crowded toward base of stem, the petioles of these leaves broad, flat, very narrowly or not at all margined, 6–10 cm long, 2–3 mm wide, widened and submembranaceous at base, rather densely spreading- or deflexed-pilose, the blades ovate, 8–11 cm long, 4.5–6.7 cm wide, very obtuse, rather deeply cordate (sinus 3–10 mm deep), coarsely crenate nearly throughout (the teeth about 10–15 pairs, very blunt, about 1 mm high, mostly 5–10 mm apart), feather-veined (chief veins 2–3 pairs), above rather

[3] Phylog. Meth. Taxon. 210. 1923.

[4] *Chrysothamnus nauseosus* var. ***abbreviatus*** (Jones) Blake.—*Bigelovia leiosperma* A. Gray, Syn. Fl. 1[2]: 139. 1884. *Aster leiospermus* Kuntze, Rev. Gen. 1: 318. 1891. *Chrysothamnus leiospermus* Greene, Erythea 3: 113. 1895. *Bigelovia leiosperma* var. *abbreviata* Jones, Proc. Calif. Acad. II. 5: 693. 1895. *Chrysothamnus nauseosus* var. *leiospermus* Hall, Univ. Calif. Publ. Bot. 7: 173. 1919. *Chrysothamnus nauseosus* [ssp.] *leiospermus* Hall & Clements, Phylog. Meth. Taxon. 217. 1923.—Jones's var. *abbreviata* is merely an insignificant form or condition of *leiospermus*, and his name, as the earliest published in the varietal category, must be adopted when the plant is treated as a variety.

light green, evenly but not densely spreading-pilose with several-celled hairs obscurely enlarged at base, soft or in age roughish to the touch, beneath rather lighter green, evenly but not densely pilose on surface with spreading hairs, densely so along costa; middle leaves not numerous, longer than the internodes, pubescent like the lower leaves, the blades ovate or lance-ovate, 4–6 cm long, about 2.2 cm wide, acute or acuminate, rounded at base, crenate-serrate mostly near middle with 3–7 pairs of teeth, the petioles 2–3.5 cm long, 2–5 mm wide; upper leaves (subtending the lower branches of the inflorescence) lanceolate, acuminate, narrowed at base, sessile, entire or nearly so, 3–5 cm long, 5–9 mm wide; inflorescence occupying about ⅓ the height of the plant, corymbiform-paniculate, rather few-headed, about 13–18 cm long, 8–10 cm wide, the branches divergent-erectish, not densely short-spreading-pilose all around or more or less in lines, the primary branches mostly 2–5-headed, not in the least racemiform, the ultimate pedicels mostly 5–22 mm long, mostly with a few small subulate or linear bracts above; phyllaries 0.5–0.8 mm wide, the green tips somewhat thickened; heads about 2.2 cm wide; disk about 9 mm high, 6–8 mm thick (as pressed); rays about 19, the tube sparsely pilose above, 2.5 mm long, the lamina linear, 2–3-denticulate, 4-nerved, about 8 mm long, 1.8 mm wide; disk corollas essentially glabrous, soon purplish above, 7 mm long (tube 2.2 mm, throat 4 mm, teeth triangular-ovate, acutish, 0.8 mm long); achenes (immature) oblong, subcompressed, hispidulous, 5-nerved, 1.8–2.2 mm long; pappus rather copious, brownish white, 6.5 mm long.

Mexico: Moist wooded canyon on the eastern slope of the Sierra de San Manuel, Municipio de Musquiz, Coahuila, 30 June 1936, *F. Lyle Wynd & C. H. Mueller* 372 (type no. 1,638,865, U. S. Nat. Herb.).

Allied to *Aster drummondii* Lindl., but apparently specifically distinct in its longer pubescence, its merely crenate lower leaves, and particularly in its relatively few-headed and open corymbiform panicle with the heads conspicuously pedicellate and not at all racemosely arranged. The inflorescence, in fact, is more like that of the average *Aster laevis* than that of *A. drummondii*.

Aster intricatus (A. Gray) Blake.

Linosyris ? carnosa A. Gray, Pl. Wright. 2: 80. 1853.
Aster carnosus A. Gray; Hemsl. Biol. Centr. Amer. Bot. 2: 120. 1881. Not *A. carnosus* Gilib. 1781.
Bigelovia carnosa Benth. & Hook.; Hemsl. Biol. Centr. Amer. Bot. 2: 120. 1881, as synonym.
Bigelovia intricata A. Gray, Proc. Amer. Acad. 17: 208. 1882.
Linosyris carnosa Greene, Fl. Franc. 384. 1897.

The well known name of this very characteristic plant, *Aster carnosus*, must be changed, owing to the existence of an earlier homonym in *Aster carnosus* Gilib.[5] The latter is merely an illegitimate name, published with a description and with *Aster tripolium* L. cited as a synonym, but nevertheless, according to Art. 61 of the International Rules of Botanical Nomenclature (1930) precludes the use of the same name for a later described species. The species was redescribed as *Bigelovia intricata* by Gray in 1882, and this

[5] Fl. Lit. 1: 214. 1781.

specific name must be taken up for it. I am indebted to Dr. F. W. Pennell for a transcript of Gilibert's description from the copy of his work in the library of the Philadelphia Academy.

Aster horridus (Woot. & Standl.) Blake.

Herrickia horrida Woot. & Standl. Contr. U. S. Nat. Herb. 16: 186. *pl. 50.* 1913.

Although this species, the type and sole member of the genus *Herrickia* Wooton & Standley, is not readily placed in any of the sections into which the genus *Aster* is divisible, it is certainly not worthy of generic separation. Its closest relationship, especially evident in the involucre, is apparently with *Aster wasatchensis* (Jones) Blake, a member of the group often separated under the generic name *Eucephalus* Nutt. *Aster wasatchensis* itself is anomalous in its group by reason of its herbaceous-tipped phyllaries, and could not be run down to *Eucephalus* by the generic key given in Rydberg's "Flora of the Rocky Mountains and adjacent plains."

Erigeron allocotus Blake, sp. nov.

Perennis caespitosus spithamaeus ubique patenti-hispidus et minute glanduloso-hispidulus subcinerascens; caules decumbentes paene e basi ramosi foliosi, ramis divergenti-erectiusculis; folia cuneata v. spathulata 3–5-fida v. 3-partita, lamina in petiolum multo longiorem sensim angustata, segmentis oblongo-ovatis v. lanceolatis v. linearibus obtusis v. acutis, folia superiora minora linearia v. lineari-spathulata integra v. 3-fida; capitula parva radiata apicibus ramorum et ramulorum solitaria longe pedunculata; involucri ca. 4-seriati parum gradati 4.5 mm alti phyllaria acuta v. breviter acuminata extima lineari-lanceolata herbacea interiora oblonga latiuscule subscarioso-marginata medio viridia; radii ca. 22–26 breves "albi" (sicc. pallide lavendulacei v. rosei); discus luteus; achenea compressa 2-nervia hispidula; pappus simplex fragilis.

Leafy-stemmed herb 13–18 cm high, many-stemmed from a slender, branched, apparently oblique caudex, the bases of the stems of the year covered with the imbricated marcescent bases of petioles, the whole plant moderately densely hispid with wide-spreading many-celled acuminate white hairs up to 1.5 mm long and also finely glandular-hispidulous; stems slender, subterete or subangulate; leaves (except the reduced upper ones) longer than the internodes, those toward base of stem crowded but not at all rosulate; lower leaves 1.7–3 (–4) cm long including petiole, light green, rather thick, the blade (about 4–8 mm long, 3–5 mm wide) 3–5-fid for about half its length or sometimes parted essentially to base, the segments mostly oblong or ovate-oblong, 1–6 mm long, 0.7–2.5 mm wide, acute or obtuse, entire or the lateral sometimes 2-lobed; middle stem leaves similar but more often deeply parted, sometimes with linear lobes; upper leaves much smaller, mostly 4–8 mm long, entire or 2–3-toothed or -fid; peduncles (naked tips of branches) mostly 3–4.5 cm long; involucre hemispheric, appressed, the outermost phyllaries herbaceous essentially throughout, 0.4–0.5 mm wide, spreading-hispid and glandular-hispidulous, the inmost about 0.8 mm wide, similarly pubescent on the green midline, this about equaling in breadth the subscarious whitish margin; heads 1–1.2 cm wide; disk 5 mm high, 6–8 mm thick (as pressed); rays about 6–7 mm long, the tube pilose above, 1.5 mm

long, the lamina narrowly elliptic, subentire or 2–denticulate, 3–5-nerved, 4.3–5.3 mm long, 1.5 mm wide; disk flowers numerous, their corollas sparsely hispidulous on base of throat, papillose-crested on the teeth, 2.7 mm long (tube 0.5 mm, throat subcylindric, 1.8 mm, teeth ovate, 0.4 mm); achenes obovate, compressed, 2.3 mm long, 0.7 mm wide, nerved on the margin, appressed-hispidulous, whitish; pappus strictly simple, of about 22 fragile hispidulous white bristles 2.2–2.5 mm long, readily detergible, leaving a minute toothed crown.

Wyoming: Dry rocky hillside, near Grouse Creek, Shell Creek Canyon, Big Horn Co., Township 53 N., Range 89 W., alt. 2285 m, 8 July 1936, *Louis O. & Rua Williams* 3283 (type no. 1,684,047, U. S. Nat. Herb.).

The 3–5-fid or -parted leaves of this plant would seem to place it in the group of *Erigeron compositus*, but it differs from the several known members of that group in its freely branched leafy stems bearing rather numerous heads, as well as in details of foliage and pubescence.

Erigeron trihecatactis Blake, sp. nov.

Annuus erectus subvalidus infra inflorescentiam simplex dense foliosus ubique dense stipitato-glandulosus in caule patenti-pilosus; folia uniformia anguste oblonga v. oblanceolata obtusa apiculata sessilia amplectentia grosse serrata lutescenti-viridia ca. 5 cm longa 1 cm lata; capitula ca. 10 cymoso-paniculata mediocria brevissime radiata; involucri ca. 4–seriati paullum gradati 6.5 mm alti phyllaria lineari-lanceolata acuminata tenuia anguste pallideque marginata; radii numerosissimi 5–6-seriati albi non exserti, lamina suberecta ca. 1 mm longa elliptica; flores disci 31 flavi; achenia 2-nervia hispidula; pappus albidus simplex corollam subaequans.

Stem rather stout, subterete, inconspicuously striate, about 65 cm high, 4 mm thick at base, yellowish green, brownish green above, densely stipitate-glandular and more sparsely pilose with slender few-celled white hairs about 1 mm long; internodes about 1 cm long; leaves mostly with fascicles in their axils, the lower deflexed, the upper erectish; blades below the middle of stem somewhat smaller than the others, about 3.5–4 cm long, 5–8 mm wide, similar to the upper in shape and cutting; middle and upper leaves 4–5.8 cm long, 9–11 mm wide, shallowly cordate-amplexicaul at the not narrowed base, not decurrent, firm, plane or very narrowly revolute on margin, coarsely serrate except toward base (teeth about 4–6 pairs, obtuse, apiculate, 1–2 mm high, 5–10 mm apart), densely stipitate-glandular and (chiefly along margin) more or less pilose, feather-veined, the veins prominulous and loosely reticulate beneath; inflorescence rounded, about 8 cm long, 6 cm wide, the heads 1–4 at tips of the few branches, the principal bracts similar to the leaves but much smaller, the pedicels 3–22 mm long, pubescent like the stem, naked or with 1 or 2 subulate bracts; heads hemispheric, 1–1.4 cm wide (as pressed), 6 mm high; involucre densely stipitate-glandular and very sparsely pilose, inconspicuously graduated, the phyllaries erect, yellowish green with narrow yellowish white subscarious margin and tip, 0.6–1 mm wide; receptacle broad, flat, alveolate especially toward the center, the margins of the alveolae toothed; rays 333 (in 1 head), fertile, the tube 2.5–3 mm long, very sparsely puberulous with several-celled blunt slightly clavellate hairs, the lamina elliptic, emarginate, 1–3-nerved, 1–1.3 mm long, about 0.3 mm wide; disk flowers 31, fertile, their corollas yellow, puberulous above the middle like the ray corollas, 3.7 mm long (tube 1.4 mm, throat

cylindric-funnelform, 1.6 mm, teeth 5, ovate, 0.7 mm long); achenes obovate-oblong, 0.8–1 mm long, 0.4 mm wide, nerved on the margin, whitish; pappus sparse, of about 17 hispidulous bristles about 3.8 mm long; style branches with deltoid-ovate obtuse papillose appendages.

Colombia: "Ad ripam rivi et in paramos," Chapinero, near Bogotá, on road to Usaquén, Dept. Cundinamarca, 12 Sept. 1926, *S. Juzepczuk* 6724 (type, Herb. Leningrad; photo. and fragm., U. S. Nat. Herb.); same locality, 28 May 1926, *Juzepczuk* 5015 (Herb. Leningrad).

This strongly marked species is a member of the Section *Caenotus*, and seems to be very distinct from any described species.

Clibadium glabrescens Blake, sp. nov.

Frutex; rami et ramuli glabri v. subglabri; folia ovata acuminata basi cuneata tenuiter petiolata serrata utrinque viridia tripli- vel quintuplinervia supra scabriuscula subtus sparse strigillosa; capitula mediocria mox remotiuscula subsessilia; phyllaria 4 late ovata v. suborbicularia obtusa saepius 9–11-nervia; receptaculum ubique paleaceum; flor. fem. 5–6, hermaph. 9–11; ovaria flor. fem. apice dense pilosa.

"Slender shrub, 4–6 ft."; branches slender, subterete, striatulate, 2–2.5 mm thick, olive-green, glabrous; branchlets glabrous or very sparsely strigillose; internodes 2–10 cm long; petioles very slender, unmargined, 2–2.5 cm long, sulcate above, strigillose in the sulcus, otherwise glabrous; blades 8–11 cm long, 4–5 cm wide, caudate-acuminate, acutely cuneate at base, serrate or serrulate from about the middle of the cuneate lower part to below the tip (teeth about 19–22 pairs, acutely callous-pointed, about 0.5 mm high, mostly 3–4 mm apart), thin-papery, above deep green, roughish, evenly but sparsely strigillose and short-strigose, beneath brighter green, evenly but sparsely strigillose on veins and surface, tripli- or usually quintuplinerved within 1–2 cm of the base; panicles terminating stem and branches, surpassed by the subtending leaves, strigillose or subappressed-puberulous, somewhat convex, at maturity 6–7 cm wide, the heads at first approximate, at submaturity mostly 2–4 mm apart; heads at submaturity (corollas fallen) depressed-subglobose, 2.5–3 mm high, 4.5 mm thick (moistened); phyllaries 4, broadly ovate to suborbicular, obtuse to very obtuse, ciliolate, toward apex sparsely strigillose, the outermost about 5-nerved, the others 9–11-nerved, 2.2–3.5 mm long, 2.5–4 mm wide; pistillate flowers 5–6, all paleate, their pales similar to the inner phyllaries, the corollas (scarcely mature) sparsely hirsutulous at apex, 1.8–2 mm long, the ovaries densely pilose at apex, the achenes obovoid, obcompressed, plump, rounded at base, densely villosulous toward apex, 2.4 mm long, 1.8 mm wide; hermaphrodite flowers 9–11, their pales much narrower than the pistillate and only 1–3-nerved, their corollas white, hispidulous toward apex, 3 mm long, their ovaries 2–2.3 mm long, pilose throughout or glabrous toward base, sometimes bearing near apex a few long gland-tipped hairs.

Colombia: Mountains between Mosoa and Sibundoy, Comisario del Putumayo, 19 May 1935, *W. A. Archer* 3415 (type no. 1,619, 557, U. S. Nat. Herb.).

A member of the section *Trixidium*, nearest *Clibadium terebinthinaceum* (Swartz) DC., in which the branches and branchlets are densely pubescent, the leaves larger, more coarsely serrate, and more densely pubescent beneath, and the heads larger.

Clibadium leiocarpum Steetz var. **strigosum** Blake, var. nov.

Rami petioli foliaque strigosa vel accumbenti-hirsuta.

Costa Rica: On brushy slope, Cerro de Piedra Blanca, above Escasú, Province of San José, 31 January 1924, *P. C. Standley* 32593 (type no. 1,225,816, U. S. Nat. Herb.).

Although this specimen may represent only a chance variation, it differs from other specimens of the species examined in a feature which is usually of considerable significance in the genus, and its separation as a variety seems advisable. The achenes in this specimen are sometimes merely clavellate-puberulous at apex, sometimes also sparsely villous.

Steiractinia lucidula Blake, sp. nov.

Frutex; rami dense strigosi, pilis basi incrassatis; folia magna ovata acuta v. acuminata basi rotundato-cuneata crenato-serrata firme pergamentacea triplinervia subtus reticulata utrinque asperula et lucidula; capitula radiata flava pro genera minuscula per 1–3 apicibus ramorum et ramulorum cymosa paniculam foliosam efformantia, pedunculis pollicaribus; involucri ca. 4-seriati gradati 9–10 mm alti phyllaria oblonga v. oblongo-ovata saepius obtusa exteriora herbacea parum strigosa et ciliata interiora tenuiora apice subscariosa et purpurascentia ciliolata; radii 5, ca. 7 mm longi; achenia alata.

Branching shrub 7–10 ft. high; stem (or branch) subterete, solid, pithy, olivaceous, 1 cm thick; leaves opposite; internodes 7–9.5 cm long; petioles stout, unmargined, densely strigose or strigillose with thickened-base hairs, those of the larger leaves 2–2.5 cm, of the leaves at base of inflorescence about 8 mm long; blades of the larger leaves ovate, about 15–18 cm long, 8–9.5 cm wide, of the leaves at base of inflorescence oblong-ovate, 9.5 cm long, 3.5 cm wide, the larger crenate-serrate from the upper part of the cuneate-rounded base nearly to apex (teeth about 20 pairs, bluntly callous-pointed, 0.5–1 mm high, mostly 5–8 mm apart), about equally green and somewhat shining on both sides, above evenly but not densely strigillose with mostly deciduous hairs with small lepidote-tuberculate persistent bases, beneath rather sparsely strigillose or antrorse-hispidulous especially along the veins and veinlets with slightly tuberculate-based hairs, triplinerved 0.8–2 cm above the base, the chief veins prominulous above, prominent beneath, the others impressed above, whitish and prominulous-reticulate beneath; peduncles in clusters of 1–3 at tips of branches and branchlets and in the upper axils, slender, mostly naked, densely erectish-hirsutulous (the hairs with small blackish tuberculate bases), 2.2–4 cm long, the whole forming a convex leafy-bracted panicle about 28 cm wide; heads about 1.5 cm wide; disk 9–12 mm high, about 7 mm thick in flower, 8–11 mm thick in fruit (as pressed); involucre campanulate, 9–10 mm high, appressed or the outermost phyllaries sometimes loose-tipped, the outermost phyllaries about 5 mm long, 1.8–2.5 mm wide, narrowly oblong or oblong-ovate, thick-herbaceous essentially throughout or pale and indurated at base, obtuse to acutish, rather sparsely strigose or strigillose and short-ciliate, the inner broader (3–3.5 mm), oblong, obtuse or rounded, above subscarious and purplish, erose, ciliolate, otherwise nearly or quite glabrous; rays yellow, neutral, sparsely ciliolate at base of limb, otherwise glabrous, the tube 2.5 mm long, the lamina oblong, bluntly 2–3-dentate, 8–9-nerved, papillate on upper surface and margin, 7 mm long, 2.5 mm wide; disk flowers not very numerous, their corollas yellow, glabrous outside, 7.5 mm long (tube 2 mm, throat

funnelform, 5 mm, teeth ovate, strongly recurved, 0.5 mm long, densely papillose and almost hirsutulous inside); pales scarious, obtuse or acutish, usually winged on the keel, ciliolate toward tip and also on the keel, 6.5–8 mm long; ray achenes (immature) inane, trigonous, not winged, erect-hirsute on the angles, about 2.7 mm long, their pappus of about 27 unequal slender hispidulous deciduous awns 1–2.5 mm long; disk achenes cuneate-obovate, compressed, 5 mm long, 3.5 mm wide (including wings), the body mottled gray and brown, erect-pilose chiefly toward apex, 2-winged, the wings thin, olivaceous, ciliate, truncate at apex and there 1 mm wide, the body contracted into a short neck which is widened into the pappiferous disk, the pappus of about 33 slender hispidulous deciduous awns, mostly subequal and about 2.5 mm long.

Colombia: Edge of woods, Mesa de los Santos, Dept. Santander, Eastern Cordillera, alt. 1500 m, 11–15 Dec. 1926, *E. P. Killip & A. C. Smith* 15366 (type no. 1,351,249–50, U. S. Nat. Herb.).

Steiractinia lucidula is most nearly related to *S. schlimii* Blake, also from the Department of Santander (Ocaña), in which the leaves are densely pubescent beneath and not shining, and the outer phyllaries rather densely strigose or accumbent-hirsute, some of them usually equaling the inmost in length.

Helianthella ciliata Blake, sp. nov.

Herba perennis pedalis, caulibus suberectis simplicibus strigoso-hirsutis foliosis monocephalis; folia subuniformia elliptica v. elliptico-obovata v. suprema lineari-lanceolata ca. 4 cm longa 1.2 cm lata obtusa v. acuta basi cuneata subsessilia integra triplinervia margine tuberculato-hispido-ciliata in paginis minute hirsutula; capitulum breviter pedunculatum ca. 4 cm latum; involucri ca. 10 mm alti ca. 3-seriati vix gradati phyllaria lineari-lanceolata acuminata laxa omnino herbacea hispido-ciliata ceterum glabra; radii ca. 11–14 aurei ca. 1.5 cm longi; corollae disci apice purpureae; paleae infra scariosae apice subherbaceae; achenia ciliata et pilosa; pappi exaristati squamellae ca. 6–8 alte laciniato-ciliatae ca. 1.3 mm longae.

Perennial with short caudex; stems few, apparently erectish, somewhat curved, 27–38 cm high, slender, striate, whitish or somewhat purplish-tinged, rather densely or sparsely strigose or substrigose and also usually spreading or ascending-hispid with several-celled white hairs; lower leaves (2–4 pairs) opposite, the others alternate; internodes 3–20 (–28) mm long; lowest leaves much reduced, obovate, about 1 cm long, those just above them elliptic-obovate, 2.5–4.2 cm long, 8–14 mm wide, obtuse, the middle ones elliptic or oblong-elliptic, 3.5–5 cm long, 7–15 mm wide, obtuse to acutish, the upper lance-linear, 2.5–3 cm long, 3–6 mm wide, acute, all light green on both sides, tuberculate-hispid-ciliate, on both sides minutely hirsutulous along the veinlets, sometimes with a few stiff white hairs along costa beneath, 3- or obscurely 5-plinerved from near the base with whitish nerves and finely reticulate, the veinlets somewhat impressed on both sides; peduncle 1–3.5 cm long, pubescent like the stem; involucre 10 mm high, 2 cm wide (as pressed), the phyllaries loosely spreading or perhaps reflexed, 1.2–2 mm wide at base, inconspicuously 3-nerved; disk (as pressed) 1 cm high, 1.2–1.5 cm thick; rays neutral, oval or oval-oblong, rather deeply and irregularly 2–3-toothed (teeth up to 3 mm long), hirsute on tube above and hirsutulous on nerves of back, about 1.5–2 cm long, about 5–9 mm wide, about 12–

nerved; disk corollas purple on the teeth, glabrous except for the densely hirsutulous teeth, 5 mm long (tube 1 mm, throat cylindric-funnelform, 3 mm, teeth 1 mm long); pales rather soft and thin, scarious below, blackish-green toward the subherbaceous somewhat hooded tip, obtuse, carinate, ciliate on keel above and densely hirsutulous at apex, about 8 mm long; disk achenes (very immature) obovate, flatly compressed, 3 mm long, 1.7 mm wide, narrowly 2-margined, notched at apex, ciliate, pilose on the sides; pappus squamellae about 3–4 on each side of achene, deeply laciniate-ciliate, connate at base, 1–1.3 mm long, equaling or surpassing the long hairs at apex of achene; style branches hispid toward apex, the appendages short, deltoid, merely finely hispidulous, acutish.

Mexico: Majalca, Chihuahua, 6 Sept. 1935, *Harde LeSueur* 156 (type no. 837153, herb. Field Mus.; photog. and fragm., U. S. Nat. Herb.); same locality, 18–20 Aug. 1935, *LeSueur* 157 and 244 (Field Mus.).

Nearest *Helianthella mexicana* A. Gray, of San Luis Potosi and Coahuila. In that species the basal leaves are much longer than the cauline and drawn down into a petiole; the stems are less leafy, with the internodes mostly longer than the leaves; the leaves are more or less hispid on both faces as well as on the margin; and the phyllaries are hispid along the back above as well as on the margin.

Verbesina callilepis Blake, sp. nov.

Herba bipedalis; caulis simplex hispidulus usque ad medium foliatus, supra nudus; folia inferiora (4-juga) opposita obovata obtusa v. acuta basi cuneata sessilia non amplectentia crenato-serrata laete viridia supra scabre tuberculato-hispidula subtus in venis sparse hispidula, superiora 3 alterna multo minora oblanceolata; capitula 3 longe pedunculata mediocria radiata aurea; involucri late campanulati 7 mm alti 3-seriati phyllaria exteriora (2-seriata) subequalia cuneato-obovata v. spathulato-obovata herbacea subappressa obtusa v. rotundata subglabra v. in margine et sparse in dorso hispidula, interiora (radios subtendentia) paullo longiora spathulato-obovata rotundata submembranacea saturate viridia aurea-marginata supra erosa: radii 9, ca. 1.2 cm longi; achenia alata glabra epapposa.

Base not seen, but doubtless perennial; stem erect or erectish, slender, 68 cm high (including peduncles), subterete, striate, purplish toward base and there rather densely hispidulous with spreading few-celled hairs, green above and more sparsely hispidulous with shorter hairs, leafy about to middle; principal internodes 4–5 cm long; lowest pair of leaves obovate, 4 cm long, 2 cm wide; next 3 pairs similar but larger, 7.5–8 cm long, 3–3.8 cm wide, apiculate, gradually cuneate-narrowed to the sessile not clasping base, crenate-serrate above the subentire cuneate base (teeth about 9–11 pairs, 3–9 mm apart, under 1 mm high, callous-apiculate), plane, papery, light green with the costa purple-red at base above for half its length, evenly but not densely tuberculate-hispidulous above (the tuberculate bases of the hairs more conspicuous toward the margin), beneath somewhat paler green, smooth to the touch, very sparsely hispidulous on veins, featherveined, the lateral veins about 5–7 pairs, with the veinlets lightly prominulous-reticulate on both sides; upper leaves 3, alternate, remote, 2.3–5 cm long, 7–15 mm wide, oblanceolate, acute, followed by a couple of remote linear-oblanceolate bracts 1 cm long or less; heads 3, about 2.5 cm wide, single on slender terminal and subterminal remote peduncles 3.5–10.5 cm long, the subtending

bracts minute, the peduncles naked, rather densely tuberculate-hispidulous below the heads; outer phyllaries 2–2.2 mm wide, the inner 2.2–2.8 mm wide; rays golden yellow, neutral, the tube hispidulous, 1.2 mm long, the lamina oval, 3-denticulate, sparsely hispidulous toward base below, 9-nerved; disk corollas (immature) golden, sparsely hispidulous on the short tube, 3.3 mm long; pales (immature) acute, sparsely hispidulous, with broad scarious margin below, above blackish green with golden yellow erect tip and margin; disk achenes (very immature) subquadrate-obovate, 1.7 mm long, 1.2 mm wide, narrowly winged, essentially glabrous, epappose.

Mexico: Infrequently scattered on tolerant pine slopes, Transition Zone, Los Cascarones, Rio Mayo, Chihuahua, 11 Sept. 1936, *H. S. Gentry* 2682 (type no. 862339, Field Museum; photograph and fragments, U. S. Nat. Herb.).

A species of the Section *Pterophyton*, nearest *Verbesina mixtecana* Brandeg. of Oaxaca. In *V. mixtecana* the stem is stipitate-glandular as well as spreading-hispid, the lowest leaves are narrowed into a petioliform base half as long as the blade, the leaf blades are smaller and much more densely pubescent with longer more or less spreading hairs, and the phyllaries are narrow, lance-oblong, and acute or subacuminate.

Coreopsis integra Blake, sp. nov.

Frutex dichotomus glaber, pedunculis et involucris subtomentoso-pilosis exceptis; folia opposita lineari-filiformia integra acuta sessilia 1.7–3 cm longa 0.5–0.8 mm lata; capitula mediocria solitaria pedunculata radiata aurea; involucri flavescenti-tomentoso-pilosi phyllaria exteriora 7–8 oblonga obtusa 4–5 mm longa, interiora 8 oblonga 9–10 mm longa; achenia longe ciliata in ventre dense pilosa in dorso subglabra; pappi aristae 2 dense antrorsim pilosae.

Shrub, 0.6 m high; stem and branches subterete, grayish brown, glabrous; branchlets greenish, striate, slender, glabrous; internodes 0.3–5 cm long, usually 1.5–4 cm; leaves acutely subulate-tipped, connate at base into a glabrous sheath 1 mm high, coriaceous, subterete in cross-section, above obscurely flattened, 1- or 3-sulcate, sordidly pilosulous along the impressed costa, beneath glabrous, rounded, (in the dried state more or less 1-sulcate), erect or ascending, light green, often with axillary fascicles; peduncles 1 or 2 at tips of branches, monocephalous, slender, pilose-subtomentose especially toward apex with flavescent hairs, naked or few-bracted, 2.3–3.2 cm long; heads 3–3.5 cm wide; disk 8–(fruit) 11 mm high, about 1 cm thick; involucre 2-seriate, 9–10 mm high, densely and flavescently subtomentose-pilose on the exposed surface of the phyllaries, the outer 1-seriate, 7–8, herbaceous, oblong, 4–5 mm long, 1.3–1.8 mm wide, obtuse, obscurely apiculate, 3-nerved, glabrescent above outside, inside densely stipitate-glandular and toward apex pilosulous, the inner 8, thick-membranous, oblong or oval-oblong, 3–4 mm wide, obtusely pointed, very many-nerved, deep brown, narrowly yellow-margined, glabrous or glabrate on margin, pilosulous toward apex inside; rays 8, neutral, golden yellow, the tube puberulous, 2.5 mm long, the lamina oval, 11-nerved, weekly 3-denticulate, 16 mm long, 6–8 mm wide; disk corollas golden yellow throughout, puberulous on upper part of tube, 5.8 mm long (tube 2 mm, throat funnelform, 2.8 mm long, teeth ovate, 1 mm); pales linear-lanceolate, 7 mm long, acuminate, about 5-nerved, pilose-ciliate, pilose dorsally; ray achenes (inane) linear, pilose-ciliate, gla-

brous on outer face, glabrous or pilose along midline on inner; disk achenes obcompressed, linear-oblong or linear-obovate, 4.8 mm long, 1.3 mm wide, blackish brown, densely long-pilose-ciliate on margins and at apex, on outer face glabrous or pilose toward margin, on inner face densely long-pilose; awns 2, densely upward-pilose, 2.8 mm long; style tips short-deltoid, hispidulous, apiculate.

Peru: On rocky eastern slope at San Carlos Mines, 6 miles west of Huallanca, Dept. Huánuco, alt. about 2745 meters (9000 ft.), 30 Sept. 1922, *J. F. Macbride & W. Featherstone* 2469 (type no. 518895, herb. Field Mus.; dupl. no. 1,198,895, U. S. Nat. Herb.).

Nearest *Coreopsis longula* Blake, from Chachapoyas, Peru, which has much longer and obtuse leaves, smaller heads (usually in 2's or 3's), much less pubescent involucre, and lance-subulate outer phyllaries.

Coreopsis sherffii Blake, sp. nov.

Frutex trichotome ramosus, ramis hexagonis glabratis, ramulis bifariam pilosulis; folia opposita internodiis saepius breviora ca. 2 cm longa, petiolo anguste cuneato-marginato ciliato, lamina ambitu deltoidea tripartita coriacea, lobis saepius anguste cuneatis 2–4 mm latis apice acute 2–3-dentatis, interdum oblongis v. oblongo-lanceolatis integris acutis; capitula mediocria usque ad 3 cm lata radiata aurea modice pedunculata in apicibus caulis et ramorum solitaria v. 3–5 cymosa; involucri glaberrimi v. solum basi ima pilosi phyllaria exteriora 8 crasse herbacea paullum obovato-oblonga obtusa v. acute apiculata 3.5–4.5 mm longa 1–2 mm lata, interiora duplo longiora membranacea oblonga rotundata saturate brunnea anguste aureo-marginata; achenia dense ciliata in ventre pilosa in dorso glabra; pappi aristae lanceolatae antrorsim pilosae.

Shrub ca. 7.5 dm high; stem subterete, striate, gray-barked, glabrous, 4 mm thick; branches of the year light brown, slender, hexagonal, pilosulous in 2 grooves, otherwise glabrous; internodes of branches mostly 2.5–4.5 cm. long, much exceeding the leaves, of the branchlets mostly 0.5–2 cm long and surpassed by the leaves; petioles very narrowly cuneate-margined to base, 5–11 mm long, pilose-ciliate with jointed hairs especially toward base, usually with fascicles in their axils, connate at base for 1–1.5 mm; blades deltoid in outline, 6–10 mm long, 6–12 mm wide, cuneate at base, 3-parted, the lobes mostly 4–7 mm long, 2–4 mm wide, plane, light green, the lateral usually acutely 2-toothed at apex, the terminal 3-toothed or 3-fid, sparsely short-pilose along costa above or usually glabrous; leaves of the branchlets mostly smaller and merely 3-fid, with linear-oblong or oblong-lanceolate entire acutely subulate-pointed lobes; peduncles 1-headed, densely spreading-pilose with flavescent hairs, 1–2.3 cm long; heads (as pressed) 2.7–3 cm wide; disk about 6–8 mm high, 7–10 mm thick (as pressed); involucre double, the outer phyllaries essentially 1-seriate, more or less obovate-oblong, appressed, pale green with 3 black vittae, the inner about the same number, 7–9 mm long, 3.5–4 mm wide, minutely erose ciliolate at the broadly rounded apex, densely brown-lineate; rays 8, neutral, golden yellow, subglabrous, the tube 1–1.5 mm long, the lamina broadly oval, shortly and bluntly about 3–4-dentate, 11-nerved, 11–14 mm long, about 7 mm wide; disk corollas golden yellow, glabrous, 4–4.5 mm long (tube 1.5 mm, throat campanulate or funnelform-campanulate, about 2 mm, teeth broadly ovate, 0.8 mm long); pales in flower oblong-obovate, obtuse, sometimes emarginate, about 4 mm long, short-ciliate toward apex,

erect-pilose on middle of back, 5–7-vittate; ray achenes inane, oblong, sparsely short-ciliate above, glabrous on the faces, epappose, 2 mm long; disk achenes (submature) narrowly obovate-oblong, 4.5 mm long, 1.5 mm wide, densely long-ciliate, sparsely erect-pilose in middle on inner face, glabrous on outer, their pappus of 2 lanceolate basally antrorse-pilose, apically hispidulous awns 1.8 mm long; style branches with deltoid acute not penicillate-tufted hispidulous appendages.

Peru: Small neat very erect (2.5 ft.) clumps on steep grassy slopes, Chinchapalca, 6 miles above Mito, Dept. Huánuco, alt. about 2900 m (9500 ft.), 16–27 July 1922, *J. F. Macbride & W. Featherstone* 1596 (type no. 518100, herb. Field Mus.; dupl. no. 1,198,886, U. S. Nat. Herb.); in half-hanging ragged clumps on steep sunny slopes, with very brittle stems, Mito, Dept. Huánuco, alt. about 2745 m (9000 ft.), 8–22 July 1922, *Macbride & Featherstone* 1482 (Field Mus., U. S. Nat. Herb.).

This fine species, distinguished from most of its allies by the cutting of its foliage, appears to be nearest *Coreopsis microlepis* Blake & Sherff, from the Province of Chachapoyas, Peru. In that plant the upper leaves are very greatly reduced, so that the heads appear to be rather numerous in an essentially naked panicle; the leaves, although sometimes rather closely similar to those of *C. sherffii*, usually have the terminal segment of the ternately parted leaf so deeply 3-lobed as to give the appearance of a pinnately 5-lobed leaf; the heads are smaller; and the outer phyllaries are ovate or oblong-ovate, only 1.5–2 mm long, 0.6–0.8 mm wide. The dried heads of *C. sherffii* impart a deep orange color to the water in which they are boiled. The species is dedicated to my friend Dr. Earl E. Sherff, whose quarter century of botanical activity, devoted primarily to the study of the Coreopsidinae, has resulted in revisions of the genera *Coreopsis*, *Bidens* (in press), *Isostigma*, *Cosmos*, *Tetramolopium*, *Lipochaeta*, *Dubautia*, and *Railliardia*, and in papers on various other groups of plants.

Calea marginata Blake, nom. nov.

Meyeria longifolia DC. Prodr. **5**: 671. 1836.

Calea longifolia Baker in Mart. Fl. Bras. 6^3: 260. 1884. Not *C. longifolia* Gardn. 1848.

The name *longifolia* is not available for this species, having been used by Gardner for a species described from Goyaz. The new name assigned refers to the conspicuous thickened margins of the leaves.

Vasquezia oppositifolia (Lag.) Blake.

Villanova oppositifolia Lag. Nov. Gen. & Sp. 31. 1816.

Vasquezia titicacensis (Meyen & Walp.) Blake.

Wedelia titicacensis Meyen & Walp. Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **19**: Suppl. **1**: 269. 1843.

Villanova titicacensis Walp. Nov. Act. Acad. Caes. Leop.-Carol. Nat. Cur. **19**: Suppl. **1**: 206. 1843.

The name *Villanova* Lag. (1816) being preoccupied by *Villanova* Orteg.

(1797), it seems necessary to replace it by *Vasquezia* Phil. (1860), as has already been done by Rydberg (in the spelling *Vasquesia*). The few species of the genus are closely related, and require a revision based on examination of the types. The two names here proposed, together with *V. anemonifolia* (H.B.K.) Blake,[6] represent the only South American species that seem to be distinct on the basis of a preliminary survey of the genus. The name *Vasquezia titicacensis* (Meyen & Walp.) Blake has already appeared in print,[7] but without the name-bringing synonym necessary for proper publication.

The proper spelling of Philippi's generic name is uncertain. It occurs five times in his Florula Atacamensis (p. 1, 31 (twice), 62, and on pl. 5). In the formal description of the new genus, and in every other case except one, the name is spelled *Vazquezia;* in the description of the new species, it is *Vasquezia.* Years later, when treating his genus as a synonym of *Villanova,* Philippi[8] twice used the spelling *Vasquezia.* The derivation of the name, obviously personal, is nowhere explained. In view of Philippi's later use of the spelling *Vasquezia,* and particularly since there was an A. Vasquez,[9] for whom the genus was presumably named, who was publishing chemical analyses of plants at the time Philippi was preparing his Florula Atacamensis, it seems advisable to adopt the form *Vasquezia.* In any case, there is no evident excuse for the spelling *Vasquesia* used by Rydberg in the North American Flora; and Philippi's single species was *V. biternata,* not *V. biterna* as given by Rydberg. I am indebted to Dr. Ivan M. Johnston for assistance in this matter.

Helenium arizonicum Blake, sp. nov.

Bienne paene glabrum, radice perpendiculato anguste conico; caulis validus 5.5 dm altus foliosus ubique erecto-ramosus; folia basalia anguste oblanceolata acuminata in petiolum multo breviorem anguste marginatum angustata irregulariter sinuato-dentata, caulina anguste lanceolata v. linearі-lanceolata acuminata integra basi dilatata breviter decurrente sessilia; capitula mediocria ca. 7–15 per caulem in apicibus caulis et ramorum solitaria; radii flavi feminei ca. 12 mm longi; discus subglobosus purpureo-brunneus 1.5–2 cm diam.; receptaculum ovoideum obtusiusculum; achenia 2 mm longa in costis pilosa; pappi paleae ca. 2 mm longae e basi lanceolata longe aristatae.

Root biennial, vertical, slenderly conic, about 10 cm long, 1 cm thick above, with few strong rootlets; stem solitary, erect, stout, striate-angled and sulcate, greenish-white, erect-branched essentially from base to apex, obscurely incurved-puberulous below, nearly glabrous above, dotted with yellow-brown glands; lower leaves 8–10 cm long (including petiole, this about 2 cm long, narrowly margined, at base ampliate, purplish, and about 7-nerved), 6–10 mm wide, triplinerved, essentially glabrous, densely glandu-

[6] Contr. U. S. Nat. Herb. 26: 261. 1930.
[7] Herrera, Pl. Cusc. Herrer. (Estud. Fl. Depart. Cuzco) 205. 1930.
[8] Cat. Pl. Itin. Tarapaca 47. 1891.
[9] Listed in the bibliography in Reiche, Grundz. Pflanzenverbr. Chile (Veg. der Erde 8:) 45. 1907.

lar-punctate on both sides, pale green; stem leaves numerous, much exceeding the internodes, the larger 6.5–13 cm long, 4–10 mm wide, long-acuminate, at base usually abruptly widened (up to 1 cm wide), semi-amplexicaul, and decurrent for 1–4 mm, the uppermost linear or linear-subulate, 2.5–3.5 cm long; peduncles solitary at tips of stem and branches, enlarged just below the head, many-sulcate, 2–11 cm long; involucre soon reflexed, the phyllaries about 14, narrowly triangular, acuminate, 7–9 mm long, 1–1.5 mm wide at base, sparsely pilose below, densely so toward tip, punctate; disk subglobose, 12–17 mm high, 15–20 mm thick; submature receptacle 5 mm. long, 3 mm thick; rays about 12 or more, cuneate, deeply 3-lobed (lobes blunt, 2.5–3.3 mm long), 9–11-nerved, 12–13 mm long, 6–7 mm wide, densely gland-dotted outside; disk corollas yellow, tipped with purple-brown, short-pilose on teeth with several-celled hairs, 3.4 mm long (tube 0.2 mm, throat thick-cylindric, 2.6 mm, teeth ovate, 0.6 mm long); disk achenes erect-pilose on the ribs with rufescent hairs, sessile-glandular between the ribs, 2 mm long; pappus paleae 6–7, subequal, 1.8–2.3 mm long, the body lanceolate or lance-ovate, 0.6–0.8 mm long, gradually narrowed into the awn.

Arizona: Near Mormon Lake, about 20 miles southeast of Flagstaff, Coconino Co., 17 June 1892, *J. W. Toumey* 681 (type no. 212077, U. S. Nat. Herb.). Additional specimen in the Gray Herbarium, with same number and locality, but dated 18 July 1892.

Both the specimens cited have been identified as *Helenium bigelovii* A. Gray, the type being so labeled in the hand of the late Dr. Rydberg. *Helenium bigelovii*, which ranges from Oregon to southern California and is not known from Arizona (Rydberg's record in the North American Flora being presumably based on this specimen), is a perennial with short nearly horizontal rootstock, simply or above few-branched stems terminated by very long-peduncled heads, entire long-petioled basal leaves, and usually broader stem leaves not abruptly ampliated at base. In Rydberg's key in "North American Flora" *Helenium arizonicum* runs down to the group containing *H. linifolium* Rydb. and *H. laciniatum* A. Gray, both of which have a slender annual root, much smaller heads, and various other distinctive characters.

Culcitium ovatum (Schlecht.) Blake.

Gnaphalium uniflorum Lam. Encyl. **2**: 752. 1788. Not *G. uniflorum* Mill. 1768.

Lasiocephalus ovatus Schlecht. Ges. Naturf. Fr. Berl. Mag. **8**: 309. 1818.

Culcitium reflexum H. B. K. Nov. Gen. & Sp. **4**: 171. *pl. 362.* 1820.

Culcitium uniflorum (Lam.) Hieron. Bot. Jahrb. Engl. **19**: 63. 1894.

The genus *Lasiocephalus* Schlecht., with the two species *L. ovatus* and *L. lingulatus* Schlecht., was published in 1818.[10] Schlechtendal remarked

[10] The date assigned in the Index Kewensis is 1814. In Dalla Torre & Harms' Genera Siphonogamarum the data 1818 is given on p. 562, and corrected on p. 637 to 1814. The title page date of vol. 8 of the Magazine is 1818. Schlechtendal's paper appeared in the "Viertes Quartal 1814. October, November, December," containing p. 241–312. As this number includes an article "Über die Witterung des Jahres 1816," beginning on p. 259, it is obvious that the number could not have been published in 1814, and, in the apparent absence of any evidence to the contrary, the title page date 1818 must be accepted.

that his material consisted of single branches from the collection of Humboldt and Bonpland furnished him by Prof. Willdenow, "der diese Gattung zuerst untersuchte, den Character essentialis feststellte und die Nahmen des Genus und der Species wählte." Despite this remark, the names have universally been attributed to Schlechtendal, and it seems as well to follow custom in this matter, since Willdenow's name is not further mentioned in connection with the descriptions. Lessing (1832), by some error, cites the name as *Oresigonia* Schlecht.

The genus *Lasiocephalus* has been referred by authors to *Culcitium* Humb. & Bonpl. (1809), but no attempt to identify Schlechtendal's two species seems to have been made. His first species, *L. ovatus*, from "monte Pichincha," is obviously the same as the later *Culcitium reflexum* H. B. K., described as from Mt. Antisana. His second *L. lingulatus*, from "America meridionali," is not so readily identified. It is natural to look for it among the six species of *Culcitium* described in the Nova Genera et Species. Among these, only *C. ledifolium* can possibly be identical. It is described as with simple, 1-flowered stem, whereas *L. lingulatum* is described as branching and with heads sometimes almost forming a panicle, sometimes solitary, binate, ternate, etc. On the whole, Schlechtendal's description is perhaps more suggestive of *Culcitium adscendens* Benth. than of *C. ledifolium*, which is known to me only from the original description. Hieronymus (l.c.), on the basis of an original specimen in the Berlin Herbarium, has referred *C. ledifolium* H. B. K. to *C. uniflorum* (*C. reflexum*), but the original descriptions indicate that the plants are specifically different, and one cannot help suspecting that some error is involved. Weddell (Chlor. And. 1: 141. 1856), who examined original specimens of both *C. reflexum* and *C. ledifolium*, kept them distinct, and his descriptions indicate that this course was correct. Schlechtendal's descriptions of *L. ovatus* and *L. lingulatus* surely refer to two different species. Under the circumstances, it seems best to transfer Schlechtendal's second name, which has obvious priority, to the genus *Culcitium* for convenience in handling it, without attempting to identify it at present with any later described species. It is difficult to reconcile his account of the variability of the inflorescence with his statement that he had only single branches of the species described; perhaps this item came from notes of Willdenow.

Culcitium lingulatum (Schlecht.) Blake.

Lasiocephalus lingulatus Schlecht. Ges. Naturf. Fr. Berl. Mag. 8: 309. 1818.

Hieracium dysonymum Blake, nom. nov.

Hieracium junceum Fries, Symb. Hist. Hierac. 144. 1848. Not *H. junceum* Bernh. Syst. Verz. Erf. 137. 1800.

Fries' name for this little known Mexican plant is preoccupied by Bernhardi's use of the same name, based on his transfer of *Chondrilla juncea* L. to *Hieracium*. I am indebted to the Lloyd Library for a copy of the entry from Bernhardi's work, which is not in any Washington library.

Hieracium junceum Fries was originally based on material collected by Liebmann in pine woods at Cambre de Ixlepec, Sierra de Oaxaca, Mexico, altitude 3050 meters (10,000 ft.). Later Fries[11] cited additional material from "Sierra de Moucayo (*Herb. Mart.* varietas angustifolia"). It is fairly clear from the general style of Fries' treatment that he was not formally naming a var. *angustifolia* here, but was merely stating that this specimen was a narrow-leaved form, and in any case no description was given. Zahn,[12] however, lists "subvar. angustifolium Fr. Epicr. 149," and adds the character "folis angustioribus, acheniis distincte attenuatis," although he does not indicate that he had examined material. He gives the locality as "Sierra de Moncayo (ex Fr. l.c.)."

BOTANY.—*A species of* Tridentaria *preying on* Difflugia constricta.[1]

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In earlier papers I described four fungi that subsist by the destruction of testaceous rhizopods inhabiting different vegetable materials undergoing decomposition in contact with the soil. Two of the fungi (4), *Cochlonema cylindricum*, endoparasitic on *Euglypha denticulata* Brown, and *Zoopage tryphera*, predacious on *Geococcus vulgaris* Francé, belong in the Zoopagaceae, a family of conidial Phycomycetes living for the most part on terricolous amoebae. The other two fungi both belong in an interrelated series of Hyphomycetes which has become known more especially, perhaps, through some widely distributed and comparatively robust members variously adapted for the capture of free-living nematodes. One of the two mucedinous forms in question (3), *Dactylella passalopaga*, preys on *G. vulgaris* and *E. laevis* Perty; while the other (2), *Pedilospora dactylopaga*, is predacious in *Difflugia globulosa* Duj. and *Trinema enchelys* Ehrenb.

A fungus strongly reminiscent of *Pedilospora dactylopaga* appeared recently in some old maizemeal agar plate cultures of *Pythium Butleri* Subr. to each of which had been added a small quantity of leaf mold collected in deciduous woods with an undergrowth of coarse herbaceous weeds. No special organs of capture could be discovered on the slender hyphae that made up its scanty mycelium. Nevertheless, when filaments on the surface of the agar substratum were traced for any considerable distance, they were found here and there to pass along the oral end of a shelled rhizopod, through the mouth of

[11] Epicr. Hierac. 149. 1862.
[12] Pflanzenreich (Heft 79) 4:[280] 1109. 1922.
[1] Received June 20, 1937.

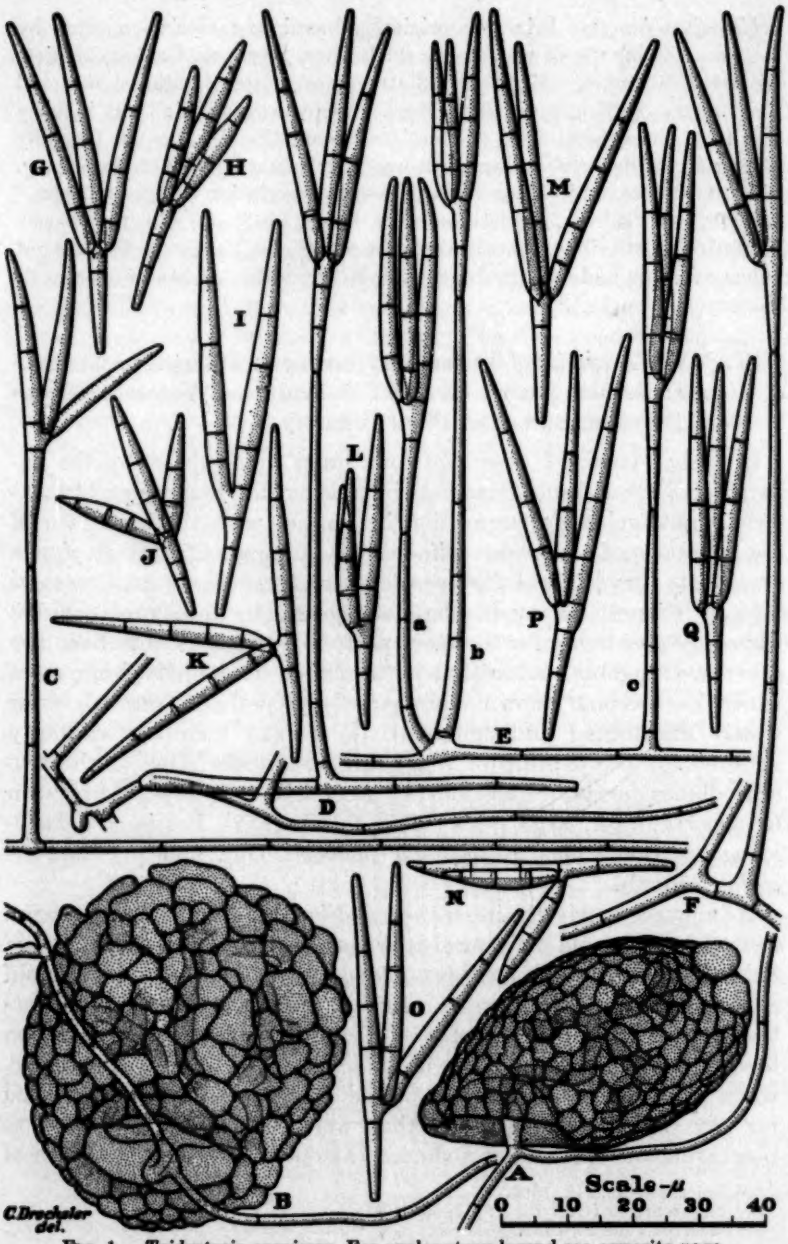

FIG. 1.—*Tridentaria carnivora*. For explanatory legend see opposite page.

which invariably a branch entered to ramify irregularly within the protoplasmic interior (Fig. 1, A, B). Manifestly the ramifying elements functioned in assimilating the fleshy contents since some of the invaded animals had been depleted to such an extent that nothing remained but the more or less crusty tests. Despite the sluggishness of their locomotion the animals presumably endured invasion and appropriation of their digestible substance only because they were prevented from escaping. Appearances indicated that capture very probably was effected through adhesion of the hypha to the extruded sarcode, although direct optical evidence of an adhesive secretion on the mycelial filaments has not yet been obtained.

In view of its normally slanting posture, much like that of *Trinema enchelys*, of its usually brownish or light brownish coloration, of its compressed ovoid shape, its inflexed mouth and its somewhat protruded anterior lip, the rhizopod destroyed by the fungus is clearly referable to the widespread *Difflugia constricta* (Ehrenb.) Leidy. Most of the specimens encountered measured about 55μ in length from anterior lip to fundus (Fig. 1, A), about 45 μ in width as viewed flatways from above or below (Fig. 1, B), and about 30 μ in thickness from front to rear at a right angle to the inclined axis (Fig. 1, A). In dimensions, therefore, they were comparable to the smaller spineless individuals of *D. constricta* figured by Leidy (11: plate 18, figs. 12, 14, 17, 18, 19,), by Penard (14: page 212, fig. 37), and by Cash (1: plate 19, figs. 14–16).

The conidiophores (Fig. 1, C; D; E, *a-c;* F) produced by the fungus in small numbers, show general similarity to those of *Pedilospora dactylopaga* with respect to stature, and like them also, bear curiously forked solitary conidia. A very pronounced difference however is at once apparent in that the spores terminate regularly in three rather than in two prongs. One of the prongs represents merely a prolongation of the basal portion of the conidium, with which portion it continues the axis of the conidiophore and forms an element analogous

FIG. 1.—*Tridentaria carnivora*, drawn from material developed in mixed culture on maizemeal agar, with the aid of a camera lucida, at a uniform magnification; ×1000 throughout. A.—Portion of hypha with a captured specimen of *Difflugia constricta* in lateral view. B.—Portion of hypha with a captured specimen of *D. constricta* in oral-posterior aspect. C.—Portion of hypha bearing a conidiophore with conidium attached. D.—Portion of mycelium with an old conidiophore that has declined to the substratum; from the prostrate conidiophore has arisen a secondary conidiophore whereon is borne a conidium. E.—Portion of hypha with three conidiophores, each bearing a conidium. F.—Portion of mycelium from which has arisen a relatively tall conidiophore whereon a conidium has been produced. G–Q.—Conidia, showing variations in size, shape and arrangement of component elements; all being of the usual three-pronged type except the two-pronged specimen I.

to the entire conidium of *Dactylella passalopaga*. At a distance from its base often equal to about one-third of its length, this axial element bears laterally a broad process that immediately divides dichotomously in a transverse plane to provide the other two prongs. Though the paired prongs are sometimes rather widely divaricate especially in conidia that have been in contact with the substratum for some time (Fig. 1, J, K, N, O), they are more usually directed upward at narrowly divergent angles to one another as well as to the axial prong (Fig. 1, D; E, *a-c;* F, G-I; L; M; P; Q).

From the manner of its development the three-pronged conidium obviously is symmetrical with respect to only one plane, that being the plane passing through the axial element and bisecting the angle between the paired prongs. When viewed lengthwise from this plane, the spore (Fig. 1, G, H, Q), especially if considered together with the hypha supporting it, presents an appearance suggestive of a trident. The similitude is of consequence in encouraging, or, perhaps, even necessitating assignment of the fungus to *Tridentaria*, a genus erected by Preuss (15) in 1852 on a single species found by him on moist disintegrating stems of *Brassica oleracea* L. and described very sketchily under the name *T. alba*. The diagnosis of the genus likewise is exceedingly brief, consisting of only a dozen words. There can be no question, at least, that the conidia were intended to be described as simple and as being united in the form of a trident, but whether the conidiophore was considered as being included in the union remains open to speculation.

Owing to its inadequate characterization the genus has not been at all kindly received by compilers. Saccardo (16), who set forth the conidiophores as terminating in simple conidia joined together in the form of a trident—an arrangement certainly not easy to relate to ordinary modes of development—added the comment that the genus had been imperfectly and obscurely described by Preuss, and hence was dubious. Lindau (12) in his first treatment of the genus characterized it in part as having very short conidiophores, and as bearing on these conidiophores solitary triradiate conidia. The portion of the description concerning the shortness of the conidiophores appears to have been based primarily on inference. On the other hand, the reference to production of solitary triradiate conidia instead of simple conidia joined in the form of a trident, is evidently to be explained as expressive of an interpretation—I believe a justifiable interpretation—whereby the individual spore was looked upon as a more inclusive unit than originally. One is tempted to submit, possibly, that

a structure held to resemble a trident might have been more accurately described by words meaning "three-pronged" or "three-tined" (as, for example "dreizackig" or "dreizinkig") than by the expression "3 strahlige"; since the proximal part corresponding to the shaft of a trident constitutes obviously a fourth radial and thus, strictly speaking, makes for a quadriradiate condition.

In his key to the genera of the Hyalostaurosporae in a later work (13: page 535) Lindau, indeed, referred to the conidia of *Tridentaria* as three-pronged and treated them as analogous in outward make-up to the two-pronged conidia of Pedilospora. Then, however, somewhat inconsistently, in defining the genus (13: page 543) he characterized the conidia as being simple and as concreted in the form of a trident,—exactly, therefore, as Saccardo had characterized them previously. Complaining, not without reason, that it was impossible to gather from Preuss' description how the conidia really look, he held that the genus might better have been rejected,—a course from which he was dissuaded by the small membership of the Mucedinaceae-Staurosporae, and the hope of arousing some profitable attention. Since its erection *Tridentaria* has had committed to it only one additional species, that being *T. setigera* published by Grove (8) in 1912. The original account of this species was accompanied by figures of compound branching structures which from the description were evidently considered as being composed individually of a three-celled conidiophore tapering toward its base and widening like a fan toward its apex, together with three conidia palmately united at their bases and collectively flanked on both sides by an acute seta. As Preuss made no mention of setae in his diagnosis of *Tridentaria*, the authors dealing with *T. setigera* in the "Sylloge fungorum" (17) quite properly raised the question whether the fungus might not perhaps better be regarded as a species of *Titaea*. The similarity of the branching structures to the conidia of *Tetracladium marchalianum* De Wild., especially as figured in a recent paper by Karling (10), suggests an alternative disposition, if, indeed, the distinction between *Titaea* and *Tetracladium* can still be maintained.

Undoubtedly the fungus preying on *Difflugia constricta* fits into *Tridentaria* better than does *T. setigera;* and better, too, than it fits into any other genus. Though its conidial prongs do not lie in one plane, and though the shoulders of its lateral prongs are comparatively narrow, yet the general resemblance of its reproductive apparatus to a trident seem more realistically suggestive than the resemblances underlying most of the names applied to fungi. The

structural design here is conspicuously different from the triradiate design that was set forth by Fresenius (6) as characteristic of the conidia of *Trinacrium subtle* Riess, and that accordingly may be held more or less typical of the genus erected on this species. To be sure, in application *Trinacrium* has not been strictly limited to triradiate forms, having been made to include *T. subtropicale* Speg. with quadriradiate conidia, as well as *T. tropicale* Speg. with conidia composed mostly of three or four radial elements whereof the proximal one is pedicelliform and shorter than the others. The former species differs markedly from the fungus destructive to *D. constricta* in the greater width (5 to 6μ) and cruciate arrangement of its conidial branches, while the latter presents equally decisive differences in its shorter ascending conidiophores and shorter conidial radiants. The genus *Tetracium* P. Henn. with quadriradiate, elongate-fusoid, pluriseptate conidia may be dismissed from consideration, for although originally described as presumably eligible for inclusion in the Mucedineae, Höhnel's study (9) of its type species, *T. Aurantii* P. Henn., refers it definitely to the Tuberculariaceae.

From its thoroughgoing similarity in biological relationship and reproductive habit to some of the Hyphomycetes known to prey on animals, the fungus under discussion must be regarded as unquestionably a member of the same predacious series. Its distinctive conidial apparatus is easily derived from that of the genus *Dactylella* Grove through branching of the solitary conidium; thereby offering an analogy to *Pedilospora dactylopaga* and to the nematode-capturing species I have described elsewhere (5) under the name *Triposporina aphanopaga*. In *P. dactylopaga* such derivation comes about through a single bifurcation of a narrow elongate conidium of the type found in *Dactylella passolopaga* and *D. leptospora* Drechsl. (5), provided that the distal elements or prongs be oriented parallel to one another; in the present fungus a similarly narrow elongate conidium bears a lateral branch that immediately bifurcates into two prongs usually diverging little from the axial prong; in *T. aphanopaga*, on the other hand, a swollen conidium of the type produced in *D. ellipsospora* Grove (7), *D. gephyropaga* Drechsl. (5) and *D. bembicodes* Drechsl. (5), bifurcates twice successively, the four distal apices diverging widely from one another. As Preuss attributed to *Tridentaria alba* "Sporis oblongis vel clavaeformibus" it may be inferred that what would now be regarded as the complete conidium of his species could be derived through appropriate branching of a clavate spore of the type represented, for example, in *D. asthenopaga* Drechsl. (5).

In any event the clavate elements ascribed to the type species of *Tridentaria* sets it apart from the fungus subsisting on *Difflugia constricta*. Since this fungus appears specifically distinct also from the few other quadriradiate species in the Mucedinaceae-Staurosporae, it is described as new under a name suggestive of its predacious character.

Tridentaria carnivora sp. nov.

Mycelium sparsum, effusum; hyphis sterilibus hyalinis, parce ramosis, mediocriter septatis, 1–2μ crassis, hac illac animalcula testacea adhaerendo capientibus, ramulum in orem cujusque intrudentibus, hyphas intus evolventibus quae carnem assumunt. Hyphae fertiles sparsae, hyalinae, septatae, erectae, simplices sed post maturitatem procidentes diende tum saepius hyphas fertilis ordinis secundi proferentes, plerumque 32–85μ altae, basi 1.7–3.3μ crassae, sursum leviter fastigatae, apice .9–1.4μ crassae, in unicum conidium abeuntes; conidiis hyalinis, vulgo ex tribus partibus ad instar fuscinae compositis,—parte longissima quae lineam hyphae fertilis producit elongato-fusoidea, recta vel leviter curvata, 5–8- loculari, 35–63μ longa, 2.8–3.8μ crassa, deorsum in hastili 1–3- loculari, 12–21μ longo, sursum in dente 3–5- loculari, 23–43μ longo consistente, inter hastile et dentem unum ramulum lateralem ferente; hoc ramulo infimo furcato atque in duos dentes 1–6- loculares 17–44μ longos apicem versus attenuatos vulgo abeunte, rarius simplici manente tum conidium bidens faciente.

Difflugiam constrictam capiens consumensque habitat in humo silvestri prope Beltsville, Maryland.

Mycelium scanty, spreading; the vegetative hyphae hyaline, sparingly branched, septate at moderate intervals, 1 to 2μ wide, here and there capturing testaceous rhizopods by adhesion, thrusting a branch into the mouth of each captive and giving rise inside to assimilative hyphae that appropriate the protoplasmic contents. Conidiophores sparsely scattered, hyaline, septate, erect, typically simple though after maturity declining to the substratum and then often putting forth secondary fertile hyphae, in any case mostly 32 to 85μ (average 60μ) high, 1.7 to 3.3μ (average 2.5μ) wide at the base, tapering slightly upward, .9 to 1.4μ (average 1.2μ) wide at the tip, terminating in a single conidium. Conidia hyaline, usually composed of three elements in trident-like arrangement,—the longest element elongate-fusoid, straight or slightly curved, divided by septa into 5 to 8 (average 6.4) cells, measuring 35 to 63μ (average 52μ) in length, 2.8 to 3.8μ (average 3.2μ) in width, its axis prolonging the axis of the supporting hypha, its proximal portion of 1 to 3 cells forming a shaft 12 to 21μ (average 18μ) long, its distal portion of 3 to 5 cells forming a somewhat tapering prong 23 to 43μ (average 34μ) long, between shaft and prong bearing a lateral spur; the spur usually bifurcating near its base into two prongs, each divided by septa into 1 to 6 (average 4) cells and measuring 17 to 44μ (average 34μ) in length; occasional elongation of spur directly into a simple branch leading to development of atypical two-pronged conidia.

Capturing and consuming *Difflugia constricta*, it occurs in leaf mold near Beltsville, Md.

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BOTANY.—*Notes on the genus* Staurogyne.[1]

E. C. LEONARD, U. S. National Museum. (Communicated by WILLIAM R. MAXON.)

Staurogyne, a genus of Acanthaceae, subfamily Nelsonioideae, was described[2] by Wallich in 1831. He published at that time a single species, *S. argentea*, citing as type a specimen collected in Sillet by F. D. Silva. The following year Nees established[3] the genus *Ebermaiera*, now considered a synonym of *Staurogyne*, describing four species, *E. humilis* and *E. thyrsoidea* from Burma, *E. axillaris* from Penang, and *E. mandioccana* from Brazil. Up to the present, various authors have recognized about 80 species. The majority of these however, were published under *Ebermaiera*, and although Kuntze[4] in

[1] Published by permission of the Secretary of the Smithsonian Institution. Received May 5, 1937.

[2] Pl. Asiat. Rar. **2**: 80. *pl. 186*, 1831.

[3] Pl. Asiat. Rar. **3**: 75. 1832.

[4] Rev. Gen. Pl. **2**: 497. 1891.

FIG. 1.—*Staurogyne agrestis* Leonard, sp. nov. A, portion of horizontal branch; B, capsule; C, the posterior calyx lobe and one of the lateral and anterior pairs; D, bractlets; E, bract; F, corolla, opened to show stamens. (All nat. size.)

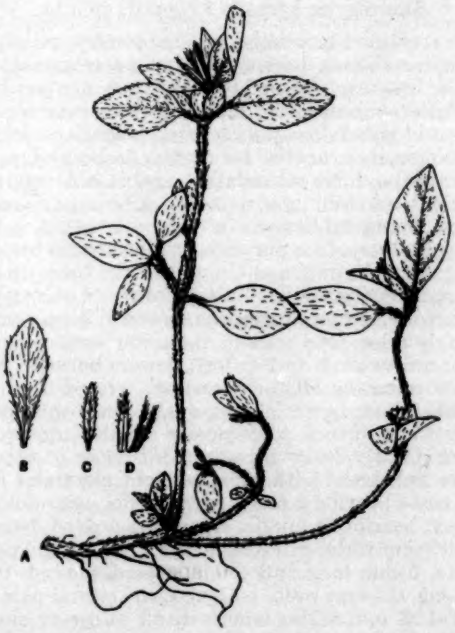

FIG. 2.—*Staurogyne trinitensis* Leonard, sp. nov. A, portion of plant, nat. size; B, bract; C, bractlet; D, posterior calyx segment and one of the lateral and anterior pairs. (B, C, D, twice nat. size.)

1891 made numerous transfers, a considerable number remain to be reclassified.

The genus *Staurogyne* consists of shrubby or herbaceous plants with usually yellow or purplish flowers borne in spikes or narrow racemes. It is readily distinguished from other genera of the subfamily by its 4 stamens (usually with a minute sterile fifth stamen or staminode) and by its irregular calyx, the posterior segment being broader and usually longer than the others.

The species of this genus are widely distributed in the tropics of both hemispheres; in America they are most numerous in the mountainous regions of eastern Brazil. Unfortunately many are still unrepresented in America herbaria.

Two new species are described in the present paper, one from Panama and Nicaragua, the other from Trinidad. Also, three are transferred from *Ebermaiera* to *Staurogyne*, one is renamed, and another is reduced to synonymy.

Staurogyne agrestis Leonard, sp. nov.

Herba; caules erecti vel procumbentes, subteretes, pilosi; folia ovata vel oblongo-ovata, apice obtusa, basi angustata, parce pilosa, petiolis pilosis; spicae terminales; bracteae oblongo-ovatae, apice acutae, basi angustatae, pilosae et glanduloso-pubescentes; bracteolae lanceolatae; calycis laciniae inaequales, pilosae et glanduloso-pubescentes, posteriore oblongo-lanceolata, 3-nervia, ceteris linearibus, acutis, 1-nerviis; corolla glabra, labio superiore bilobo, inferiore trilobo, lobis rotundatis; capsula oblonga, glabra vel apice minute pubescens; semina minuta, ovoidea, minute papillosa.

A low herb, becoming subligneous at base; stems much branched, erect or procumbent, subterete, often purplish, the lowermost branches spreading, up to 20 cm long, curved upward at tip, pilose, the hairs up to 1.5 mm long; petioles up to 7 mm long, pilose; leaf blades ovate to oblong-ovate, up to 3.5 cm long and 2 cm wide, obtuse at apex, narrowed at base, sometimes purplish with age, sparingly pilose, the hairs of the lower surface confined chiefly to the costa and lateral veins (6 to 9 pairs); flowers borne in narrow spikelike racemes (these terminating all the branches), crowded or the lowermost distant, the rachis pilose; bracts oblong-ovate, the lowermost about 10 mm long and 5 mm wide, thence successively smaller upward, acute at tip, narrowed at base, faintly 3-nerved, appressed-pilose or subglabrous above, the lower surface pubescent with short straight glandular hairs about 0.25 mm long or the costa bearing a few longer slender eglandular ones; pedicels up to 1.5 mm long, bearing at middle a pair of 1-nerved, lanceolate bractlets 5 mm long and 1.5 mm wide; calyx segments unequal, the posterior segment oblong-lanceolate, 5 mm long and 1 mm wide, 3-nerved, the anterior pair linear, 4.5 mm long, 0.5 mm wide, 1-nerved, the lateral pair subulate, 4 mm long and about 0.25 mm wide, 1-nerved, all pilose or shortly glandular-pubescent; corolla 5 or 6 mm long, glabrous, purple (?), the tube 1 mm in diameter below middle, thence enlarged to 1.5 mm at throat, the 2 upper lobes rounded, about 1 mm wide, the lower middle lobe obovate, 1.5 mm long, 1.75 mm wide, the lateral lobes oval and somewhat smaller; filaments

1 mm long, glabrous; anther lobes 0.5 mm long; staminode slender, 0.5 mm long; style 2 mm long, glabrous; capsule oblong, 1.5 mm wide at base, gradually narrowed to 0.75 mm near tip, glabrous or bearing a few minute hairs at tip; seeds ovoid, light brown, 0.5 mm long, minutely roughened.

Type in the U. S. National Herbarium, no. 1,225,111, collected in a wet field between Matías Hernández and Juan Díaz, Province of Panamá, Panamá, January 21, 1924, by Paul C. Standley (no. 31936).A plant collected in Nicaragua by Charles Wright on the U. S. North Pacific Exploring Expedition under Commanders Ringgold and Rodgers is of this species.

Staurogyne agrestis is probably a close relative of *S. repens* (Nees) Kuntze, from Matto Grosso, Brazil, but differs in its bushy habit and much larger leaves. The leaves of *S. repens* are described as oblong-lanceolate, 6 to 7 lines long and 2 to 2½ lines wide, and its habit as repent, but in *S. agrestis* we have a bushy herb with possibly the lower branches procumbent and the leaves ovate to oblong-ovate and as much as 3.5 cm long and 2 cm wide. The inflorescence, bracts, corollas, capsules, and pubescence of the two species are similar, however.

Staurogyne trinitensis Leonard, sp. nov.

Herba; caules decumbentes, pilosi; folia ovata, apice obtusa, basi angustata, utrinque parce pilosa; racemi compacti, breves, terminales; bracteae oblongae, apice acutae vel subobtusae, parce pilosae; bracteolael anceolatae, apice acutae, pilosae; calycis laciniae inaequales, pilosae, ciliatae, posteriore lineari, ceteris subulatis; corolla parva, glabra, labio superiore bilobo, inferiore trilobo, lobis rotundatis; capsula glabra.

Decumbent herb; stems about 30 cm long, rooting at the lower nodes, pilose, the hairs up to 1 mm long; leaf blades ovate, up to 3.5 cm long and 1.7 cm wide, obtuse at apex, narrowed at base, thin, sparingly pilose on both surfaces, the hairs of the lower surface confined chiefly to costa and lateral veins (4 or 5 pairs); petioles up to 1 cm long, pilose; flowers borne in short terminal spikelike racemes up to 1.5 cm long; bracts oblong, 7 to 12 mm long, 1.5 to 3 mm wide, acute to subobtuse at apex, sparingly pilose; pedicels 0.5 to 1 mm. long, bearing at middle a pair of lanceolate pilose bractlets 5 to 6 mm long and 1 mm wide, acute at apex; calyx segments 5 to 6 mm long, pilose and ciliate, the hairs up to 1 mm long, the posterior segment linear, about 0.7 mm wide, 3-nerved, the others subulate, barely 0.5 mm wide near base, 1-nerved; corolla 5 or 6 mm long, glabrous, the lobes of the upper lip rounded, about 1 mm wide, the middle lower lobe ovate, about 1 mm wide, the two lateral ones similar but somewhat smaller; filaments 2 mm long, glabrous; anther lobes barely 0.5 mm broad; style 2.5 mm long, glabrous; capsule (immature) glabrous, about 1 cm long.

Type in the Britton Herbarium, New York Botanical Garden, collected on the road to Caroni Estate, Arima, Trinidad, April 5, 1866 (Trinidad Herbarium no. 2900, the collector unknown).

Apparently unrelated to any other American member of the genus. An appended note by N. E. Brown states that the specimen does not match any American material at Kew but is near the Indian *S. zeylanica* (Nees) Kuntze.

Staurogyne brachiata (Hiern) Leonard, comb. nov.

Ebermaiera brachiata Hiern in Nat. For. Kjöbenhaven Vid. Medd. **1877**: 69. 1877.

Type collected at Rio de Janeiro, Brazil, by Glaziou (no. 3070).

Staurogyne wawrana Leonard, nom. nov.

Ebermaiera gracilis Wawra, Itin. Princ. Coburgi **1**: 94. *pl. 10.* 1883; not *Ebermaiera gracilis* T. Anders. (1867).

Type collected in "Wälder von Alto d'Imperador," Petropolis, Brazil (Coll. II. 55).

Staurogyne itatiaiae (Wawra) Leonard, comb. nov.

Ebermaiera Itatiaiae Wawra, Itin. Princ. Coburgi **1**: 93. *pl. 11.* 1883.

Type collected in "Hochwälder des Itatiaia," Brazil (Coll. II. 434).

Staurogyne warmingiana (Hiern) Leonard, comb. nov.

Ebermaiera Warmingiana Hiern in Nat. For. Kjöbenhavn Vid. Medd. **1877**: 68. 1877.

Type collected "in marginibus silvarum ad Serra da Piedade," Brazil, by Warming.

STAUROGYNE VAUTHIERIANA (Nees) Kuntze, Rev. Gen. Pl. **2**: 497. 1891.

Ebermaiera Vauthieriana Nees in Mart. Fl. Bras. **9**: 15. 1847.
Staurogyne macrantha Lindau in Bull. Herb. Boiss. **5**: 643. 1897.

Type collected at Villa Rica, Prov. Minas Geraes, Brazil, by Vauthier (no. 182). The type of *Staurogyne macrantha* was collected near Itacolumy, Prov. Minas Geraes, Brazil, by Schwacke (no. 10495).

ZOOLOGY.—*A new pocket gopher of the genus* Cratogeomys *from Mexico.*[1] E. A. GOLDMAN, Bureau of Biological Survey.

In a revision of the pocket gophers of the genus *Cratogeomys* by E. W. Nelson and the writer,[2] 25 geographic races assigned to four species were recognized. Since the revision was published I have had occasion to examine three specimens from near timber line on Mount Orizaba, Vera Cruz, the highest mountain in North America south of Alaska. The specimens were referred by Elliot[3] to typical

[1] Received May 24, 1937.
[2] Proc. Biol. Soc. Washington **47**: 135–154. 1934.
[3] Cat. Coll. of Mammals in Field Columbian Mus., Pub. 115, Zool. ser. **8**: 310. 1907.

Cratogeomys perotensis but are now found to exhibit characters that are distinctive.

For the opportunity to describe this new subspecies I am indebted to Dr. Wilfred H. Osgood of the Field Museum of Natural History

Cratogeomys perotensis peraltus, subsp. nov.

Timber-line Pocket Gopher

Type.—From near timber line on Mount Orizaba, Vera Cruz, Mexico (altitude about 12,500 feet). No 13831, ♂ adult, skin and skull, Field Museum of Natural History, collected by Edmund Heller, July 5, 1904.

Distribution.—Known only from the type locality on the upper slope of Mount Orizaba, western Vera Cruz, Mexico.

General characters.—Similar in size and color to *Cratogeomys perotensis perotensis* of the higher slopes of the Cofre de Perote, and to *Cratogeomys perotensis estor* of Las Vigas, at a lower elevation on the eastern edge of the interior plateau in western Vera Cruz. Differing notably from both *perotensis* and *estor* in cranial details, especially the peculiar form of the nasals and adjoining bony elements.

Color.—Type (acquiring fresh pelage): Upper parts from top of head over back to rump near "sayal brown" (Ridgway, 1912) moderately mixed with black, becoming lighter and near "cinnamon" along sides, forearms, and thighs; under parts thinly overlaid with dull buff, the light plumbeous basal color showing through; middle of face and muzzle blackish; auricular patches deep black; a white patch at upper base of tail; fore feet brownish; hind feet white; tail thinly haired, dark brownish above, somewhat paler below.

Skull.—Very similar to that of *perotensis* in general form, but nasals shorter, barely reaching anterior plane of zygomata, less tapering and wedge-shaped, the posterior ends decidedly broader, more rounded; premaxillae narrower, less extended posteriorly, ending in plane of lachrymals (usually reaching slightly beyond this plane in *perotensis*); frontals broader between premaxillae and reaching farther forward along median line to meet correspondingly broad ends of nasals; squamosal portion of lambdoid crest lower, less trenchant, rising more nearly vertically over mastoid process, instead of strongly bent forward as in *perotensis;* jugal broader anteriorly, inserted farther forward in maxilla; lateral margins of palate more excised behind posterior molars; pterygoids rather broad, with more prominent lateral wings; molariform teeth slightly narrower; crown of last upper molar somewhat more quadrate, less triangular, the posterior lobe broader, and the outer side less oblique. Compared with that of *estor* the skull is similar in size, but departs in detail as follows: Nasals broader, less tapering and wedge-shaped posteriorly; premaxillae narrower, about equaling nasals in transverse plane near posterior ends of latter (premaxillae wider than nasals near posterior ends in *estor*); braincase broader anteriorly, tending to develop more prominent postorbital processes at fronto-parietal suture; zygomata lighter, slightly more squarely, spreading anteriorly, the upper surface of maxillary roots narrower; frontals broader anteriorly between premaxillae; palatal grooves shorter, ending at posterior palatine foramina which are placed farther forward near transverse plane between first and second upper molars (grooves longer and ending at palatine foramina near plane between second and third upper molars in *estor*); crown of last upper molar somewhat more quadrate, less triangular, the outer reëntrant angle little developed; tubercle over root of lower incisor less prominent.

Measurements.—Type: Total length, 315 mm; tail vertebrae, 90; hind foot, 42.5. Two adult male topotypes, respectively: 300, 305; 92, 82; 41, 41. *Skull* (type): Greatest length (median line), 57.6; zygomatic breadth, 41.3; width across squamosals (over mastoids), 36; interorbital constriction, 8; length of nasals, 21.3; maxillary toothrow (alveoli), 10.7; upper incisors (width of cutting edge), 8.2.

Remarks.—Cratogeomys p. peraltus is apparently restricted to the upper slopes near timber line (about 12,500 feet) on Mount Orizaba. Its range may be interrupted below by that of the much smaller pocket gopher, *Thomomys umbrinus orizabae*, which is very numerous, at least on the west slope, at 9,500 feet.

Specimens examined.—Total number four, three skins and skulls and one additional skull, all in the Field Museum of Natural History.